

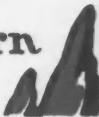
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THE CONDOR

VOLUME 47

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A STUDY OF CAPTIVE GALAPAGOS FINCHES OF THE GENUS GEOSPIZA

By ROBERT T. ORR

INTRODUCTION

The Galapagos Islands, because of their isolation and peculiar fauna and flora, have been of keen interest to naturalists since they were visited by Charles Darwin in 1831 during the voyage of H. M. S. Beagle. Among the many biological problems which these oceanic islands have presented none has proven more difficult than those concerning the origin and development of that group of native passerine birds commonly known as ground finches. Certain species of these birds are superficially so divergent that until recent years forms now known to be closely related were placed in widely separated families of the Passeriformes. This avian group, now considered by some to represent a separate fringillid subfamily, known as the Geospizinae, was first thoroughly monographed by Swarth (1931) who greatly contributed to our knowledge of its relationships. In his estimation it merited recognition as a separate family for which he proposed the name Geospizidae (Swarth, 1929). The justification for such separation has been denied by most taxonomists subsequently.

The study of systematic allocation and relationships of the various geospizids was carried to a further stage of development by David Lack (1945) who published a detailed account of variation occurring within the group. This monograph contributed considerably toward clarifying the relationship and origin of certain forms, and also it presented an analysis of observations made in the field upon geospizid behavior and ecology. It was the expedition to gather information pertaining to the latter part of Lack's work that made the present study possible.

On leaving the Galapagos Archipelago in April, 1939, after five months of intensive field work, Mr. Lack brought with him thirty-one live finches. He had originally planned to transport these birds to England but their condition upon reaching Panamá and the imminence of war in Europe made it advisable to bring them to the United States. Accordingly, Mr. Lack approached the California Academy of Sciences and arrangements were made for the Academy to take care of them. Later the writer agreed to undertake a behavior study of these captive birds, although it must frankly be admitted not without some misgiving and considerable skepticism at first as would be natural to one primarily interested in field observation. These sentiments were soon lost, however, when it was found that the behavior pattern appeared essentially the same in captivity as in the wild, allowing of course for the artificial environment. Furthermore, it was soon discovered that experimental methods, which would be impractical or impossible in the field, often shed new light on certain phases of behavior.

Grateful acknowledgment is here made, both personally and on behalf of the California Academy of Sciences, to Mr. David Lack for this generous gift, and also to those organizations that sponsored Mr. Lack's expedition, the Royal and Zoological societies of London and the Elmgrant Trustees, Dartington Hall, Totnes, South Devon, England.

To Mr. Eric C. Kinsey of Manor, Marin County, California, the writer is deeply grateful. Mr. Kinsey generously kept these birds in his own aviaries for several months after their arrival in San Francisco and contributed valuable advice in the planning of new aviaries on the roof of the North American Hall of the California Academy of Sciences in Golden Gate Park where the birds were later kept. For many helpful suggestions and criticisms the author wishes to thank Dr. Robert C. Miller, Director of the California Academy of Sciences and the late Mr. James Moffitt, Curator of Birds and Mammals in the same institution. Many contributed to the care and feeding of these birds, especially Miss Grace Irene Crowe who also assisted greatly in the final preparation of the manuscript.

SPECIES

Thirty of the thirty-one live birds secured on the Galapagos Islands survived the trip to San Francisco. Four of the fourteen species of geospizids recognized by Lack were represented. There were three *Geospiza magnirostris*, four *Geospiza fortis*, twelve *Geospiza fuliginosa* and eleven *Geospiza scandens*. All except two *fortis* and one *fuliginosa* were secured at Academy Bay on Indefatigable Island. These three birds were captured at Progreso on Chatham Island.

The four species represented are identical as regards color of plumage, the adult males being entirely black except for the under tail coverts which are margined with pale buff. The immature males vary from a female-like plumage through various partially black stages. The females are streaked grayish brown. The principal differences among the four species involved are in body size and in the shape and proportions of the bill. *Geospiza magnirostris* is the largest, its body about equaling that of a large Crossbill (*Loxia curvirostra*) but its bill is enormous, being even larger than that of an Evening Grosbeak (*Hesperiphona vespertina*). *Geospiza fortis* is slightly smaller, more nearly approaching a Purple Finch (*Carpodacus purpureus*) in size and with a bill averaging proportionately smaller than in *magnirostris*. *Geospiza scandens* is about the same size as *fortis* but, instead of possessing a heavy coccythraustine-like bill, its bill is long and starling-like in character. The smallest of the four species involved is *Geospiza fuliginosa* which is not much larger than a Pine Siskin (*Spinus pinus*); whereas its bill is relatively heavy, it is more nearly of normal finch-like proportions. All the species involved possess the usual geospizid characteristics, that is, a relatively stocky body, short tail, rounded wing poorly adapted for long sustained flight, and long, dense feathers of the rump and lower back. For a detailed description of the individual species the reader is referred to Swarth (1931).

The mortality was relatively high for the captive birds in the year 1939, undoubtedly due to several factors. Among these may be mentioned the climatic change the birds were subjected to in coming from the Galapagos region to the San Francisco Bay area, the fact that they were not used to confinement, and, lastly, the incompatibility of certain birds which resulted in severe fighting with fatal injuries occasionally inflicted.

Eight birds were lost by the end of the first year. These included three *Geospiza fuliginosa*, two *Geospiza scandens*, and three *Geospiza fortis* which left only one male of this species represented. During 1940 and 1941 only two losses occurred. These were both *Geospiza scandens*. The heavy losses in 1939, however, were compensated for by exceptional success in the rearing of young during the following year. Unfortunately, with only one *fortis* remaining it was impossible to increase the numbers of this species. This was very much regretted as it had been planned to attempt to hybridize both *magnirostris* and *fuliginosa* with *fortis* which is intermediate in size. The surviving male *fortis* was exceedingly wild and refused to mate with females of either of the two pre-

viously mentioned species. Nine of the original stock, including six *fuliginosa*, two *scandens* and one *magnirostris* were sent to the New York Zoological Society on February 10, 1942. It is not known what the survival rate among this group has been. Two of the eleven remaining birds of the original stock kept in San Francisco died during 1942. These were both *G. fuliginosa*. One loss of an individual of this same species occurred in 1943. No losses occurred during 1944. Thus at the close of the latter year, five years and eight months after their arrival in San Francisco, thirteen of the original thirty geospizids received were known to have died, nine were sent to New York and their fate is unknown and eight were still living in San Francisco. The latter comprised two *magnirostris*, one *fortis* and five *scandens*.

CAGES

An adequate aviary was constructed with the assistance of labor provided by the Work Projects Administration during the summer of 1939. Cages were made sufficiently large to accommodate large brush and tree cuttings so as to facilitate breeding on the part of the birds. The aviary was placed on the roof of the North American Hall of the Academy's buildings and was so situated as to be protected from wind on the north and west sides and exposed to the southward in order to receive the maximum amount of available sunlight and warmth.

This aviary was forty feet in length, seven feet in height and ten feet in depth and was divided into ten separate cages by means of wood and wire mesh partitions spaced four feet apart. The framework was made of two by three inch and two by four inch redwood lumber and was covered with one-quarter inch wire mesh. Doors five feet in height and two feet in width were present at the front of each cage. The back of the aviary was against a concrete wall and both the roof and sides of the cages were boarded for a distance of four feet from the back of the aviary. This afforded protection from rain and wind as well as secluded nesting sites. The roof was covered with mineral surfaced Malthoid roofing. Additional protection was given the birds by extending boarding down from the front end of the four-foot boarded roof a distance of two feet. The remainder of the roof was of wire mesh. Both the floor and the roof of the cages sloped to the south at about a 7° angle, to allow for drainage. The floor of the cages was covered with an additional two-inch layer of small gravel. Perches were placed both in the protected and open parts. A feeding box with a waterproof roof was placed inside of the cage just to the left of the door.

FOOD

According to Lack (1945:39) the native diet of the species considered here is composed principally of fruit, berries, flowers, flower nectar, young green leaves, buds, seeds, occasional caterpillars and other small insects. Aware of the rather varied type of food normally eaten by these birds, a diet was suggested by Mr. Eric C. Kinsey which proved very successful. This consisted principally of bird seed mixture, a substitute nectar food and either berries or greens. The nectar food was concocted of honey, Mellin's baby food, evaporated milk and water. *Pyrocantha* and cotoneaster berries of several varieties commonly used in horticulture were relished by the birds. These were available principally during the winter months. In the spring, summer and early autumn sow thistle (*Sonchus oleraceus* and *S. asper*) proved highly satisfactory as food. The flowers, green seeds and leaves were all consumed and as sow thistle is often heavily infested with aphids this additional insect food was eaten. When neither berries nor sow thistle were obtainable, dandelion flowers or lettuce leaves were used as substitutes. An abundance of fine gravel and a piece of cuttle bone was furnished to each cage.

Berries or greens were either eaten on the ground or carried to a perch and eaten. It was quite characteristic of the caged birds to let the wings droop slightly when foraging over the ground in search of food. At such times, likewise, the tail was regularly bobbed up and down and frequently fanned. On several occasions members of the species *Geospiza fuliginosa* were noted attempting to capture on the wing small insects that flew into the cages.

Considerable care had to be used with certain birds to prevent them from becoming excessively fat. Some individuals became so overweight that their wings failed to lift them off the ground. This was found to result from the excessive eating of seed, almost to the exclusion of other items of food, and was remedied only by the elimination of seed from the diet for varying periods of time.

GENERAL BEHAVIOR

There have been many accounts written describing the tameness of Galapagos birds but, as indicated by Lack (1945), geospizids show more fear of man than do most of the other native land birds of that region, seldom allowing a human to approach closer than six feet. Many individual differences in this regard were exhibited by captive birds, both those secured in the wilds and those hatched and reared in captivity. Among the former, certain individuals were moderately tame when they first arrived in San Francisco while others were quite wild. These wild individuals never became tame, even after several years in captivity, although they did finally cease beating themselves against the cages whenever approached, as they had done at first. Young, upon leaving the nest, were usually quite wild but as a rule were readily tamed. A few, however, always exhibited a great deal of wariness.

Members of all the species studied showed a considerable degree of inquisitiveness. *Geospiza scandens* seemed to excel in this character and the young of all species after they were several months old showed greater curiosity in their surroundings than did adults. When a new bird was placed in a cage with subadults, the latter would evince great interest in it, following it closely as it moved about the cage often to the obvious annoyance of the newcomer. Any new objects placed in their cages were carefully examined and pecked at with the bill. The tamer individuals would often perch on the author and other persons with whom they became familiar and gently grasp at buttons, eye glasses, pencils, coat lapels, fingers and even ear lobes. In this regard mention may here be made of the manner in which *G. scandens* diverged somewhat from the other species in the use of the bill. Tame individuals when perched on the writer's hand frequently used their bills to pry his fingers apart. By opening the mandibles after the bill was inserted between two fingers considerable pressure was exerted, sufficient at least to force relaxed fingers apart. Sometimes individuals would peck violently in woodpecker fashion. Members of this species invariably peeled all the bark off the branches and twigs of brush and tree cuttings in their cages. Perhaps in the native state many insects are secured as a result of this habit of peeling bark.

In general somewhat fewer conflicts appeared to occur between members of different species when kept in the same cage than was true where individuals of the same species were confined together. One instance occurred wherein a pair of *G. magnirostris*, confined in the same cage with an adult male *G. scandens*, built a nest, laid eggs, incubated, and hatched young without any serious conflict taking place. The male *magnirostris* would occasionally fly at the male *scandens* and attack but the latter would usually attempt to keep out of the way. Most of the chasing occurred during the earlier

stages of the breeding cycle at which times the male *magnirostris* was principally concerned with chasing his own mate.

Aggressiveness seemed to vary a great deal with individuals. Some males would constantly try to make violent attacks on males in adjoining cages, irrespective of the species. Other males were only mildly aggressive, their attack consisting principally in flying toward other males perched on the wire screen of adjacent cages, no attempt being made to use the bill. In other instances breeding males showed nearly complete indifference to adjacent males even of the same species. For the most part, however, males of the same species were incompatible during the period of breeding activity.

On several occasions Oregon Juncos (*Junco oreganus*) and Allen Hummingbirds (*Selasphorus sasin*) were released in the same cages with geospizids. The only reaction on the part of the latter to juncos was a normal curiosity such as would be exhibited upon the release of a new individual of their own species in the cage. When hummingbirds were released, however, the reaction was quite different. Galapagos finches would pursue a hummingbird and one gained the impression that they were trying to catch a moth.

The flight of captive members of the genus *Geospiza* is relatively weak as would be expected of species possessing relatively short, rounded wings, a stocky body and a proportionately short tail. Perhaps more noticeable, however, is their inability to maneuver in the air. This lack of agility, as it may be termed, was especially conspicuous when local species such as Song Sparrows (*Melospiza melodia*) and Oregon Juncos (*Junco oreganus*) were placed in the same cage with Galapagos finches. The former species could hover and wheel about in the flyways, while the finches would normally fly in an approximately straight line from one point to another and if alighting on the screen sides would hit with considerable force. *Geospiza scandens* appeared to have the strongest and most rapid flight as well as the greatest agility of any of the species studied. *Geospiza fuliginosa* on the other hand showed the weakest type of flight.

PAIR FORMATION IN CAPTIVITY

The normal breeding period for members of this group in the Galapagos Islands extends from mid-December to April. This is correlated with the rainy season. Some years when there is an exceptionally prolonged rainy season nesting may continue until June and there are indications that breeding, to a limited extent, may take place in almost every month in the year. Unusual climatic conditions may be responsible for this latter fact.

Birds maintained in captivity bred from March to November, inclusive, and there were evidences of some nesting activity on the part of a few individuals during every month in the year. In general, however, the nesting period for most of the captive birds was confined to spring and summer, in this regard conforming to the habits of most North American species.

In late winter and early spring the males were first to show an increase in sexual activity. This was indicated either by an increase in song in those individuals which sang to some extent throughout the year, or by the beginning of song on the part of those that had ceased singing by the end of the previous summer. The instigation of song appeared correlated with increased activity on the part of the males. They flew about their cages considerably more and occasionally attempted to attack other males in adjoining cages. This stage was followed by the chasing of the female by the male. Sometimes the male would begin to pursue the female within a week after the incep-

tion of song or it might be a month before the chasing began. This sexual flight was accompanied or in some instances preceded by the carrying of nesting material by the male. Often this was carried about the cage in a vague sort of way for some weeks before any nest was constructed. The chasing of the female and the carrying of nesting material by the male was usually continued until such time as the female was ready to participate in the nesting activities. There were instances, of course, in which the female became sexually active before the male. Under these circumstances she generally became the aggressor and did the chasing.

Experiments involving the switching of members of pairs so as to change mates during the peak of the breeding season brought some interesting results. On several occasions pair formation between individuals from different cages, where they already had mates, took place instantly when they were placed together. Copulation sometimes followed within a few seconds after which both individuals would jointly participate in the construction of a new nest in which eggs would be deposited within several days. This, of course, was not the usual thing, occurring only when two birds of opposite sexes in the same advanced sexual condition were placed together. Many individual differences were noted, certain males being much more responsive than others and certain females being more aggressive than others, the behavior of the latter, of course, depending to a large extent upon the dominance of the males.

This matter of dominance or of aggressiveness was quite striking among the caged pairs. Certain males were so aggressive that if confined with a docile female that was known to be ready to mate the male would chase and harass her so violently it would be necessary to remove the female to prevent her death.

To cite an example of this, at 4 p.m. on June 24, 1940, an aggressive male *scandens* was placed in a cage with a female which had been seen carrying nesting material. The male had shown so many signs of sexual activity, as evidenced by song, the carrying of nesting material, extreme aggressiveness toward other males and an inclination to chase females, that it had been found necessary previously to place him in solitary confinement. When the two birds were placed in a new cage together, both looked it over for a few minutes, then the male picked up nesting material that had been deposited there and shortly afterward began carrying it to a selected site, apparently starting a nest. Within one-half hour he was seen to chase the female. The following morning at 9 a.m. the female showed signs of having been severely chased and was cowering in a corner of the cage. She was immediately removed. A female from a near-by cage was then placed with the male. This female had already paired with a male, built a nest and was very aggressive, in fact so much so that she had regularly chased the male with whom she had been mated. When she was released, she flew down to the gravel on the floor of the cage. The male immediately flew down beside her and sang. He then fluttered his wings, raised his bill upward, emitted a shrill drawn out note and circled her closely, posturing as he did so. The female then postured and copulation immediately followed. As soon as the act was completed the male threw his head back and, with mouth open, shrilled and fluttered in circles about her for almost one minute. After this he flew about the cage a bit, singing whenever he perched, vibrating his wings as he did so. Later he chased the female a bit and worked on the nest which had been started the previous day. This was half built on this morning and was three-fourths complete by noon. In the ensuing few days the male chased the female a bit but she did not seem very much afraid of him, although she did attempt to avoid him. The female during the following few months only showed sporadic interest in nesting. The male continued in song, occasionally built nests, and maintained his generally aggressive behavior. As a general rule

it was found that birds of either sex tended to be aggressive if they became sexually active before their mate. Females obviously in a sexually active condition were noted chasing males which failed to respond. This did not occur frequently, however, as the male usually was first to show signs of sexual activity and instigate sexual flight.

In the summer of 1941 a wild-taken adult female *G. magnirostris* that had hatched four broods of young in 1940 lost her left foot. This was the result of her biting a leg band so that circulation was cut off at the base of the tarsometatarsus. No attempt was made to remove the band at the time the injury was discovered for fear of infection. Ultimately the foot was amputated and by autumn of that year the stump was completely healed. It was feared that this would seriously interfere with breeding activities on her part. The following summer and autumn, however, she successfully reared one brood and hatched another, all of which unfortunately died due to a severe storm. Again in 1943 she successfully reared young and in 1944 laid again, although the eggs were destroyed, possibly by house mice. The behavior of this one-legged female and her mate was perfectly normal. In only one respect did they differ from other pairs and this was in the location of the nest. It was placed inside the food shelter rather than in brush cuttings in the cage. This may have been accidental as certain birds constructed nests on ledges in their cages. On the other hand it appeared that the problem of constructing a nest by a female so handicapped was greatly simplified by the selection of the box-like food shelter as the site.

SONG

A rather complete account of song in the geospizids has been given by Lack (1945). It is felt unnecessary, therefore, to give any detailed account of this subject here. As generally understood song serves two primary purposes. First it is a means of announcing territory by a male to other males of the same species and second it is used as a means of advertisement to females of the same species on the part of an unmated male desirous of a mate. Its function, therefore, is two-fold, but its action normally is confined to other members of the same species. Furthermore, among most birds, even those closely related, each species has its own characteristic song which is distinguishable from that of other species.

This specific distinctness of song, as has long been known, does not hold true among the Galapagos finches. In the four species studied in captivity individual differences between the songs of males of the same species were often much greater than between males of different species. In fact no two males of the same species had songs that even closely resembled each other, whereas, in several instances, males of different species had nearly identical songs.

Lack (*op. cit.*:33) states that "all of the species watched were, at times, seen to attack individuals of most of the other species of Geospizinae." He goes on to say, however, that such attacks are sporadic in occurrence and usually of short duration. Furthermore, bill recognition in a frontal attack usually causes a complete collapse of such aggressive behavior when an alien species is encountered. In captivity certain males exhibited an extremely aggressive attitude to neighboring males of different species. Wire screen partitions prevented actual contact and may likewise have interfered with recognition.

If it were not for Lack's implication to the contrary, one might almost suspect that territorial conflicts would easily occur among those closely related geospizids that are essentially alike in their general behavior, food habits, and nesting habits, and which even flock together outside of the breeding season. If such similarity in habits exists, there must be interspecific competition for food and nesting sites during the reproduc-

tive period. The unusual overlapping in song, therefore, may possibly serve a very definite purpose. Where such song is common to several species it might readily serve as warning to males of any of those species against encroaching upon an occupied territory and thus tend to reduce overcrowding among competing species. This method would often fail of course in the case of an aggressive intruding male of a different but closely related species. Under such circumstances one would expect bill recognition to cause a cessation of aggressive behavior as soon as the established male and the intruder came to grasping bills. A less aggressive male, however, might be deterred from attempting to establish territory close to males of a different species but which possessed the same song. Further observations in the field would be necessary to determine this.

While song in general was quite variable in the group of captives, it consisted for the most part of from one to five syllables, joined together and repeated either slowly or rapidly without much musical quality. The only striking variation from this generalized song pattern was exhibited by a wild-taken male *magnirostris* which had a song very reminiscent of the liquid *ookalee* characteristic of North American blackbirds of the genus *Agelaius*. This blackbird-like song is mentioned by Lack (*op. cit.*:29).

Song in all four of the species studied is often preceded or succeeded by a rather shrill, descending whistle. This is most marked during the peak of the sexual period and is of the same type as that uttered when posturing.

Very few of the young males hatched and reared in captivity ever developed much of a song. In most instances it consisted of a single note accompanied by the whistle. This, however, did not in any way deter them from mating.

It was noted during the first fall, winter and succeeding spring, after the birds were received from the Islands, that the males sang more when it rained. The actual falling of the rain appeared to act as a stimulus inducing song. This was thought significant in view of the fact that the breeding season in the Galapagos Islands is correlated with the rainy season. Furthermore, the noise of running water and various mechanical sounds such as those made by an air blower or radio similarly were found to stimulate song among certain males at almost any season of the year. This mechanical stimulus, of course, is well known to canary breeders. Intense rain and severe storms inhibited song and usually caused a temporary cessation of all nesting activity.

Several of the other types of call notes which were commonly used by members of this group may be mentioned here. A buzzy, wren-like *churr* was the most frequent note. This was uttered when foraging or feeding or when two birds came close together. In the latter case it would sometimes be given more harshly and appear to be a warning note. When danger was detected a sharp, high-pitched *thup* was given at varying intervals until the source of disturbance had passed. These notes were common to members of both sexes. The female, likewise, had a characteristic series of rapidly uttered notes which was given when posturing, just prior to the copulatory act.

The young males developed a juvenal type of song which was found to be essentially the same for all species, although it varied to some extent with the individual. It consisted typically of a series of warbling notes loosely connected. This song was not uttered loudly. It reminded the writer of the song of the Ruby-crowned Kinglet (*Regulus calendula*) as given softly in the early spring by wintering males prior to their return to their breeding grounds. Once this song was acquired, it was repeated almost constantly during the day and was apt to vary over a period of time with the individual.

Juvenal song usually began at the age of six to eight weeks although one young individual was heard singing when four weeks old. It rarely lasted more than a few months

and sometimes terminated as abruptly as it began. Among the young males reared in captivity the juvenal song was most frequently replaced by a harsh *churr*. This single note often comprised the only adult song ever acquired, except during the breeding period when it was supplemented by the shrill whistle previously described. One young male *Geospiza scandens* developed an adult song at four and one-half months of age. Its song resembled the blackbird-like note of an adult male *G. magnirostris* which was housed in the same cage. This song was given periodically from February to May, after which the bird became silent.

POSTURING

The males were observed to posture a great deal during the period in which both members of the pair participated in the building of the nest. This behavior became more frequent as the nest neared completion and then abruptly decreased when egg-laying commenced. It practically ceased during incubation and later when the young were being fed in the nest, although a few exceptions were noted.

Many of the postures of the geospizids are described by Lack (1945:24). One of the most typical postures of the captive birds appears, however, either to have been overlooked or not seen by that author. This was a swaying posture on or very near the nest which was often participated in by both members of a pair. Both birds would crouch facing each other with the neck slightly arched and the bill partly open and sway rhythmically from side to side. The male sometimes would utter the shrill descending whistle at such times. Usually the female or, occasionally, the male would be perched on the nest. The female rarely postured more than a foot or two away from the nest and copulation rarely took place any farther away. Any attempts on the part of the male either to copulate or to posture too close to the female when away from the immediate vicinity of the nest would cause the female to assume an aggressive posture. She would crouch in a menacing attitude and remain motionless except to follow him with her head. Sometimes, instead, the warning wren-like scold was given. Posturing and copulation sharply decreased with the laying of the first egg.

A most characteristic feature of the male when posturing was the presence of nesting material in the bill. Before posturing the male invariably picked up a token bunch of nesting material. Long before the female became sexually active the male developed this habit of carrying nesting material. Frequently he sang with this still in the bill although more often it was forgotten and dropped when singing.

Lack comments upon the same attitudes assumed for sexual and aggressive behavior in the Geospizinae. This was not exactly borne out by captive birds. In sexual behavior the wings were invariably quivered whereas in no instance in the species studied was this true where the behavior was directed against males in adjoining cages. In the latter situation the wings were raised and advanced forward but not vibrated. Sometimes when perched on the side of a cage the lower wing was advanced very far forward. The principal similarity appeared to rest in the fact that the wings were elevated and occasionally the mouth was partly opened and the head swayed from side to side.

Several experiments were carried on involving the placing of mounted specimens of various species and sexes in the cages of sexually active males and mated pairs. The results are here recorded.

On June 27, 1940, a mounted skin of a female *Geospiza scandens* was placed on the floor in a cage with a male *G. magnirostris*. The latter immediately flew down and postured with fluttering wings and open upturned bill, emitting a shrill whistle. Following this several attempts were made to copulate with the mount. The skin of the female

scandens was then removed and replaced by a skin of a female *G. fortis*. This produced the same type of behavior on the part of the male. After removing the female *fortis* skin and leaving the male alone for a few minutes both the female *scandens* and *fortis* skins were placed together in the cage with the former nearest the male. The latter, however, immediately went to the *fortis* skin which was farthest away, postured and attempted copulation. The two skins had been selected for their similarity in appearance. The only noticeable difference was in the shape of the bill, that of the *fortis* of course more nearly resembling *magnirostris*. After these two skins were removed, the skin of a female Red-winged Blackbird (*Agelaius phoeniceus*) was placed on the floor of the cage. The male postured a little before it, then made an attempt at copulation. Lastly, a skin of a female *magnirostris* was placed in the cage. This failed, however, to produce any reaction or even interest on the part of the male.

These experiments merely showed that a progressive decrease in interest in specimens occurs when they are continually placed with sexually active caged males. Discrimination of species was only indicated when a choice was offered and at such time the female of the species most nearly resembling that to which the male belonged was selected.

Another series of experiments was made with a pair of *Geospiza scandens* which had shown definite signs of sexual activity. On March 1, 1940, skins of both male and female *G. fuliginosa* were placed in the cage at different times. They aroused only casual interest on the part of either member of the pair. Similarly a mirror, placed vertically on the floor of the cage, only aroused normal curiosity. On June 27, 1940, the skin of a male *scandens* placed in the cage greatly excited both the birds, causing them to utter notes of alarm. The male then attacked the skin viciously. When it was replaced by the skin of a female *scandens*, the male displayed and attempted to copulate with it.

On this same day experiments were made with two other pairs of *Geospiza scandens*. In the first instance a female *scandens* skin was placed in the cage. This immediately caused the male to posture and attempt copulation. This was repeated six times. The male even went through the copulatory act when the skin fell on its side and then lay on its back. A male *scandens* skin placed in the cage after this was warily approached and then ignored.

This same type of reaction to a female *scandens* was observed on the part of the male of another pair of this species the same day. In this instance the female *scandens* skin was later replaced by that of a female *Geospiza fortis*. This resulted in the male posturing but not attempting copulation. When the *fortis* skin was replaced by that of the female *scandens* skin, once more the male only postured. This was removed and several hours later a skin of a female Red-winged Blackbird (*Agelaius phoeniceus*) was placed on the floor of the cage. The male then postured and tried to copulate with it. Several days later, on July 1, the male attempted copulation with skins of a Song Sparrow (*Melospiza melodia*) and an immature *Geospiza magnirostris* in first year plumage.

Numerous experiments were performed on the reaction of male geospizids to their own reflection in a mirror. Almost invariably during the breeding season they would attack their own image, fighting until so exhausted it was necessary to remove the source of trouble to avoid injury. At other times of the year, however, their image in a mirror only aroused casual interest.

NEST BUILDING

Caged pairs were kept plentifully supplied with nesting material, particularly when signs of sexual activity were manifested. Sisal hemp fiber, cut in lengths of from six

to eight inches, was found most useful for this purpose. Sometimes this was supplemented with dry grass and old nests of various icterids (both *Agelaius* and *Icterus*). Certain other extraneous materials in the cages, such as feathers and pappus from sow thistle (*Sonchus*) heads, were also used by the birds.

Among captive birds, just as in the wild, the male often built one or more nests a month or two before the female showed any sign of sexual activity. Sometimes after completing a nest the male would tear it down only to start building again immediately. Occasionally nesting material was removed from one nest and carried to another as it was required.

When a female finally became interested in building, she would either accept one of the completed nests of the male, merely modifying it a bit so as to add the finishing touches, or, irrespective of the presence or absence of a completed nest, she might begin the construction of an entirely new nest.

Although both members of a pair worked on the nest, the majority of the work was seen to be done by the female. The male carried material in his bill a great deal but more often than not it was only a token which was kept while flying around, singing and posturing. Occasionally he brought it to the nest or even passed it to the bill of the female if she were in the nest. Females were not so often seen carrying nesting material but when they did so it was solely for purposes of construction.

The male, not infrequently, would pull material out of one part of the nest and, after flying about with it for a while, bring it back and add it to another part of the nest or offer it to the female if she were there. In one instance a pair of *Geospiza scandens* was seen to work for several weeks at the end of which time they had accomplished very little. The female industriously collected nesting material and brought it to the site apparently selected for the nest. The male just as industriously took the material from the nest site and scattered it about the cage.

The nests constructed by captive birds were generally domed with an entrance on one side. Many modifications of this, however, were noted. Sometimes the nest would be cup-shaped without any dome covering it. At other times it would be but partly domed over. Occasionally nests were built with two entrances instead of the usual one. This latter type of nest has already been recorded by Gifford (1919:236).

EGGS

The eggs of all the species studied are essentially alike, differing only in size which varies in proportion to body size. They are white, lightly speckled with brown. The usual number of eggs in a clutch is 3, although among captive birds the number was found to vary from 1 to 5. For *Geospiza fuliginosa* the average number of eggs for 17 sets laid in captivity was 3.1, with extremes of 1 and 5. Thirty-two wild-taken sets in the Academy collection average 3.3, with extremes of 1 and 5. Eleven sets of *G. scandens* eggs laid in captivity averaged 2.9 eggs per set, with extremes of 1 and 4. Ten sets of *G. magnirostris* eggs laid in captivity averaged 3.0 eggs per set, with extremes of 2 and 4.

Eggs as a rule were laid on successive days and generally before 9 a.m. Incubation normally started with the laying of the last egg. In one instance, however, a female *G. scandens* did not begin incubating until four days after the last egg was laid. This appeared to be abnormal.

The incubation period was found to vary from 11 to 14 days. The average time required for hatching 16 sets of eggs was 12.3 days. The variation in the incubation period does not indicate any specific difference as the extremes were recorded for the same species.

Under captive conditions no reliable information could be obtained regarding the normal number of sets laid annually. Certain pairs seemed to be sexually active throughout the year. One female *Geospiza fuliginosa* laid during every one of eight consecutive months, from March to October, producing 10 clutches totaling 31 eggs. Only the removal of all nesting material finally prevented further laying as it was feared the overstrain might injure the female. Other mated females never laid. Many deserted their nests after eggs were laid only to lay again after a few days or weeks. Males were frequently responsible for the destruction of eggs.

Among the sets which were fully incubated in a seemingly normal manner the percentage of fertility was very low. This was believed at first to be a result of living in captivity but perhaps this condition prevails also in the wild. Beebe (1924: 157-158) comments upon the fact that fifty per cent of the eggs of four species of geospizids examined were infertile and suggests "The absence of enemies, or the effect of some other environmental insular relaxation has apparently called forth this subtle but quick response,—a conserved correlation of offspring average." The possibility that the virtual absence of native predators might in some way be responsible for this high degree of infertility occurred to the present writer some time before he discovered the same idea expressed by Beebe. It seemed to offer a solution, at least in part, to the problem of population checks in this insular group which has very few natural enemies, although under similar circumstances other species generally attain the same end by a reduction in the number of eggs laid.

The following figures show the number of eggs incubated by members of three of the species of *Geospiza* studied over a period of several years and the number of these eggs that were fertile: *G. magnirostris*, 30 eggs, 23 fertile, *G. fuliginosa*, 53 eggs, 13 fertile, *G. scandens*, 34 eggs, 12 fertile. Eggs which were deserted or broken, either accidentally or on purpose, before fertility could be determined are not included in the above figures.

COURTSHIP FEEDING

Courtship feeding is of regular occurrence among the Galapagos finches. Perhaps in its simplest form it consists in the placing of food by the male at the feet of the female. Among the captive birds such food presented by the male usually consisted of the flowering heads of dandelions or sow thistle, either one of which was placed in the cages for food daily. Sometimes the transference was from bill to bill, especially if the birds were perched on twigs or perches. Whole berries were occasionally presented to the female in this manner by the male. The term symbolic feeding used by Tinbergen (1939:224) would adequately apply to this type of behavior.

The usual method of courtship feeding, however, was by regurgitation of food on the part of the male. Although the male might feed the female any time after she became actively interested in the construction of the nest, this generally was not observed until a few days before the eggs were laid. Feeding of the female by the male continued until some time after the young left the nest. In instances where the nesting activity of pairs was prolonged it was continued occasionally for some months.

Certain males indulged in courtship feeding very infrequently, others fed their mates regularly. As a general rule this transference of food took place away from the nest although on a number of occasions females were observed being fed while perched on the rim of the nest or even while sitting on eggs. While being fed or when begging for food the female would usually flutter her wings, behaving very much like young birds under similar circumstances. Females were noted begging most often after the young had left the nest but while they were still dependent upon the parents for food.

GROWTH AND DEVELOPMENT OF YOUNG

The following account is a summary of observations made on the growth and development of numerous broods of *Geospiza magnirostris*, *G. fuliginosa* and *G. scandens*. No significant differences, other than those imposed by size, were observed between the young of any of these three species.

At time of hatching the young were found to be essentially naked and flesh colored as previously described by Beck (1924:159). There were a few small tufts of pale, buffy colored down situated on the following parts of the body: above and slightly posterior to each orbit, on either side of the occiput or, as was sometimes the case, appearing as a band across the occiput, on each of the future humeral and femoral tracts, on the future spinal tract and in the region where the greater secondary coverts later made their appearance. The remiges were indicated by a faint bluish color at the point of growth of each feather papilla along the posterior margins of the wings. The eyes appeared bluish beneath the lids which were unopened. The bill varied from bright yellow in some individuals to almost flesh color in others, although the angle of the mouth was always yellow. An egg tooth was present. The feet and legs were flesh colored and the nails appeared transparent whitish.

The young were fed regurgitated food by the parents within several hours after hatching. At this time they feebly raised their heads and opened their mouths whenever the nest was jarred. No audible sound was made by the young on the first day.

Little change was apparent on the second day (between one and two days old) aside from the normal increase in size and strength. Toward the end of the second day the bluish areas on the wings where the remiges were forming were more conspicuous.

On the third day the outlines of the remiges were quite apparent beneath the surface of the skin on the upper and posterior parts of the wings. No other feather tracts were visible. The young at this stage could be heard calling faintly for a distance of four feet.

On the fourth day the remiges had grown so that in some individuals they protruded through the skin. The greater and middle coverts were also quite apparent. The dorsal feather tract was usually faintly visible. The young when fed could clearly be heard calling at a distance of eight feet from the cage.

The eyes were still unopened by the fifth day. The remiges definitely protruded from the skin at this stage; also the greater wing coverts on the tips of which were attached some of the down feathers which were overlying them originally. The median coverts also protruded from the skin. Most of the feather tracts of the body except those on the top of the head were at least slightly indicated. No change as yet was apparent in the color of the soft parts. An increase in voice could be noted at this time.

On the sixth day the eyelids were slightly separated and the eyes appeared as slits between them. The young still raised their heads and opened their mouths when the nest was touched. The secondaries and "tertiaries" were seen breaking through the tips of their sheaths, but the primaries had not quite reached this stage. All the principal feather tracts of the body were apparent, at least to some extent, even on the top of the head, although only the humeral tracts, aside from the remiges, protruded through the skin. Next to the humeral tracts the anterior portion of the dorsal tract was perhaps most advanced; the feathers were nearly ready to break through the skin. The voice had increased in volume considerably by this time. No color changes in the soft parts were apparent. The egg tooth was still present. The young clung tenaciously to the nest whenever an attempt was made to pick them up.

By the seventh day the eyes were opened to a greater extent, although the head was still raised and the mouth opened whenever the nest was touched. The feet, tarsi and nails showed some darkening, giving them a slightly vinaceous appearance. The primaries as well as the primary, greater and middle coverts were beginning to break through their sheaths. The secondaries were most advanced. The lesser secondary coverts were apparent. The alula quills and their coverts were seen breaking through their sheaths. The under wing coverts and axillars were not yet visible. The feathers of the capital tract were beginning to protrude through the skin and those of the femoral, humeral, ventral and spinal tracts were well through the skin. The caudal tract was well developed with the rectrices bursting through their sheaths while the crural feather tracts were still poorly developed.

On the eighth day the young still tended to open their mouths when the nest was touched. The legs and feet were more vinaceous than on the previous day. The secondaries and tertiaries showed the greatest advancement so far as feather development was concerned. In *Geospiza magnirostris* they averaged about 2 mm. beyond the ends of the sheaths. The primaries, greater and middle coverts were all breaking through their sheaths as also were the alula quills and their coverts. The primary coverts and lesser coverts were about ready to break through their sheaths. The under wing coverts and axillars were not yet in evidence even beneath the skin. The feathers of the femoral tracts were more advanced than those of other parts of the body, having already broken through their sheaths. Some of the feathers of the humeral tracts also had broken through as had those of the most anterior part of the spinal tract. Those feathers of the capital tract that had made their appearance were, for the most part, protruding through the skin. The crural tracts were very limited, each consisting of about half a dozen feathers to be seen on the lower shank. These barely protruded through the skin. The rectrices and upper tail coverts were breaking through their sheaths. No under tail coverts nor any feathers of the anal circlet were to be seen. Feathers of the ventral tracts were bursting through their sheaths at this stage.

On the ninth day the young still raised their heads when the nest was touched lightly. If it were moved much, however, they would crouch down and remain very quiet. The legs and feet still showed a progressive darkening. The primaries were all through as were the secondaries and "tertiaries." These feathers in *Geospiza magnirostris* were from 1 to 3 mm. beyond the ends of their sheaths. The primary, greater and middle coverts had all broken through their sheaths as was also true of the alula quills and their coverts. Most of the lesser coverts were breaking through. There were no signs of any under wing coverts or axillars. The feathers of the femoral tracts were still more advanced than those of any of the other body tracts, being well fluffed out at this age. Those of the humeral tracts extended far beyond the broken tips of their sheaths. All of the feathers of the spinal tract had broken through. The feathers of the capital tract all protruded through the skin; the more posterior ones were about ready to break through their sheaths. The few feathers of the crural tracts had not as yet burst through, although they protruded through the skin of the shank. All twelve rectrices were now through their sheaths and about six upper tail coverts were in evidence and nearly ready to burst through. Neither under tail coverts nor feathers of the anal circlet could yet be seen. All feathers of the ventral tracts were through their sheaths.

By the tenth day the young could be heard calling fifty feet away. They raised their heads and opened their mouths when the nest was touched lightly but remained quiet and looked slightly beligerent if it were moved very much. Measurements of young *Geospiza magnirostris* at this age showed the primaries to extend from 4 to 8 mm. beyond the broken tips of the sheaths. The secondaries and "tertiaries" averaged longer in general, the longest secondary being 9 mm. beyond the tip of its broken sheath. The primary coverts were from 2 to 5 mm. beyond their sheaths. The greater coverts extended from 4 to 7 mm. beyond the tips of their sheaths while the median coverts similarly extended from 2 to 4 mm. All the lesser coverts had broken through. The alula quills were about 6 mm. beyond their sheath tips and their coverts were well developed. No under wing coverts or axillars could be seen. The most posterior feathers of the capital tract were breaking through and all the feathers of the humeral tracts were already through. This, likewise, was true of the spinal tract, although the most anterior feathers were more advanced than the others. The feathers of the femoral tracts were all fluffed out while the few crural feathers were just breaking through. The rectrices in *Geospiza magnirostris* on this day were 1 to 1.5 mm. beyond the tips of their sheaths. The upper tail coverts were about to break through and approximately four small under tail coverts could be seen protruding through the skin. No feathers of the anal circlet were yet to be seen. The ventral tracts were well advanced and the feathers were fluffing out. At this stage the young stretched their wings a great deal. The bill was essentially unchanged in color.

During the eleventh and twelfth days all the feather tracts which had broken through showed rapid progress in development. The least advanced feathers present were those of the anterior part of the capital tract which, however, had broken through. The anal circlet, axillars and under wing coverts generally had not made their appearance by this time. The feet and legs had become noticeably darker.

The young occasionally left the nest by the thirteenth day. The wings were not sufficiently strong for flight but they assisted considerably in hopping and balancing. In some individuals the under wing coverts, axillars and feathers of the anal circlet were indicated by this time, although feathers still were lacking on the under side of the head and upper neck. The bill showed some indication of darkening, just median and also anterior to the nostrils. The legs and feet were fairly dark though not yet approaching the coloration of the adults. No additional crural feathers nor under tail coverts had made their appearance.

Usually by the fourteenth day all the young were out of the nest. Those that had left on the previous day were generally able to hop about quite agilely and used their wings to some extent. In *Geospiza magnirostris* at this age the wing from the bend measured as much as 55 mm. The only remnants of down to be seen were attached to the tips of the feathers dorsal and posterior to the eyes on either side of the head. The time of appearance of the under wing coverts, axillars and feathers of the anal circlet varied considerably. In some individuals they made their appearance at about two weeks of age, in others, not until they were three weeks old. The upper mandible showed a faint darkening around the nostrils by the end of the second week.

At three weeks of age the feathers of the anal circlet, the under wing coverts and the axillars had usually appeared, at least to a limited extent. At this age feathers were also making their appearance on the underside of the head and neck, although it was several days before they broke through their sheaths. The darkened area around the nostril was more apparent. The young were still fed by the parents.

At four weeks of age the young were picking up food of their own accord and about able to feed themselves. The male at this time often attacked the young viciously, as though in effort to drive them away from the nesting territory. This probably succeeds in the wild but with cage-reared young it often resulted in severe injury to the bills of the juveniles. The young were noted bathing at this age. A few more axillars and under wing coverts were apparent and the chin and neck were well feathered. The basal portion of the upper mandible was quite black.

When five weeks old the entire basal half of the upper mandible was black, although the lower mandible was still unchanged. The legs were the color of those of the adult female. Juvenal song was sometimes heard.

The juvenal plumage, when fully acquired, was somewhat similar to the first year plumage, differing, however, in the structure of the body feathers and in the nearly complete absence of ventral streaking. The body feathers were fewer in number than in later plumages and were soft and loose due to the greater space between the barbs and barbules. This resulted in much of the basal gray showing through, thus producing a drab color in combination with the terminal buff of the feathers.

At six weeks of age the upper mandible was about two-thirds black and juvenal song was well developed. Certain individuals were even noted carrying nesting material. Postjuvenal plumage frequently made its appearance at this time and many new feathers could be seen breaking through their sheaths along the dorsal and ventral body tracts as well as the median and lesser wing covert tracts.

By seven weeks of age the basal portion of the lower mandible was black. Postjuvenal feathers were making their appearance over most of the body feather tracts. Some of these appeared in regions which were unfeathered during the juvenal phase, as on the legs, with the exception of the shank, and median to each of the juvenal ventral tracts. Only the rectrices, remiges, primary coverts, the alular quills and their coverts appeared not to be replaced during this molt.

The bills of young hatched in captivity appeared to grow until about the tenth week. In some instances slight growth was noted after this time but it was difficult to determine whether or not this was due merely to the fact that normal wear did not occur under conditions in captivity.

CARE OF THE YOUNG

Both the male and female parents participated in caring for the young while the latter were confined to the nest. By the time the young were ready to leave, however, the male was doing most of the feeding. Observations made upon geospizids in the

Galapagos by Lack (1945:28) indicate that the rôle of feeding is entirely the responsibility of the male once the young have left the nest. This did not hold true for captive birds. In many instances the male did the majority of the feeding but nevertheless the female did contribute in this work. Several times females were seen to feed young while incubating a new clutch of eggs. Sometimes this behavior would continue to within a day or so of the hatching of the succeeding brood.

Difficulties occasionally arose as a result of males attacking young when the latter had been out of the nest a week or slightly longer. Under such circumstances it was frequently necessary to confine the male to a small retaining cage within the nesting cage in order to prevent the young from being killed. Consequently the problem of feeding the fledglings rested entirely with the female. This habit of attacking the young, occasionally exhibited by the males, seemed probably to be a result of inadequate diet which may have retarded the speed of development of the offspring. Possibly when the normal time arrived at which the males would drive the young from the nest territory, under natural conditions, the captive reared young were not sufficiently advanced to care for themselves and could not, therefore, be removed.

On a number of occasions males of several species were found to kill the young or remove them from the nest and drop them on the ground as soon as they hatched. This habit, however, was generally lost after several sets of young were so destroyed.

The young invariably were fed regurgitated food. The parents at such times were kept plentifully supplied with greens and flower heads and, whenever possible, aphids. During the first breeding season (1940) preserved grasshoppers of the type sold commercially for bait fishing were also added to the diet. Owing to World War II, however, it was not found possible to secure these in succeeding years. Hard boiled egg was occasionally supplied to nesting pairs. In transferring food the bill of the parent was thrust far down the throat of the young.

The nest was maintained in a sanitary condition by the removal of all fecal sacs upon deposition. Both parents performed this duty.

MOLTS AND PLUMAGES

The sequence of molts and plumages in geospizids, the time required by the males in some genera to acquire black plumage, and the question as to whether certain males ever become fully black have been problems long puzzling students of this group. It is believed that the evidence presented in the following account will be of some assistance in arriving at a solution to certain of these problems. To settle completely all of the disputable matters involved, however, it seems likely that further study of a good many if not all the forms in their native environment or at least under semi-captive conditions in the Galapagos area is necessary.

Information derived from museum specimens aided greatly in the interpretation of facts derived from observations on living birds. So far as could be determined from the evidence presented by the very large series of study skins in the collection of the California Academy of Sciences, there is no indication that more than one molt normally occurs each year after postjuvinal plumage is acquired. This series represents the various forms of the genus *Geospiza* taken in every season of the year and it includes all ages. The occurrence of but a single molt was largely borne out by observations on captive birds although, as will be seen, some exceptions were noted. That these exceptions were due to environmental conditions in captivity and do not regularly occur in the wild seems most likely. It must be remembered that the captive birds were maintained in San Francisco which is at 38° N. latitude, in contrast to their native Galapagos Islands situated essentially on the Equator. The results obtained during the first year when the

birds were becoming acclimated to northern hemispheric conditions were obviously abnormal as later observations showed. Likewise, the molts of some of the young hatched in 1940, the year following the arrival of the parent stock in San Francisco, failed to conform with those of young hatched in succeeding years with the exception of one individual hatched in 1943.

It is readily understood that a certain period of time would be required for the physiological adjustment of birds transported from their equatorial home to 38° N. latitude before their molt periods would correspond with those of northern birds. The normal time for the annual molt in this group is from late February to early June or approximately at or near the completion of the breeding season. As noted by Lack (1945:52) and others, however, breeding possibly may occur during any month in the year. This, likewise, was found to be true in the case of certain captive individuals. Since the annual molt of adults usually follows the breeding season, it is not surprising that a certain amount of irregularity as to its time of occurrence is indicated in extensive series of study skins. This, combined with the fact that there is a great deal of individual variation in the plumages of the young males as well as adults, no doubt is responsible in part for the present confused state of knowledge on the subject of geospizid plumage.

All thirty birds received in San Francisco on April 29, 1939, directly after coming from the Galapagos Islands, either had just completed their annual molt or were still in process of doing so. Some of these were young of the year, and consequently they were undergoing their postjuvinal molt. In the latter part of August and during September of the same year all the original birds that had survived again went through a complete molt. This would indicate a relatively rapid adjustment on their part to northern conditions as this is about the time most passerine species in the United States undergo their annual molt. In succeeding years these same birds have had but a single molt during the year. This has usually taken place between the middle of August and the early part of October. Occasionally, however, a few feathers were noted coming in on the head and neck of some individuals as late as January.

Since accounts of the natal and juvenal plumages as well as the postjuvinal molt are given in the section on growth and development of young for the species studied (see p. 189), the present discussion will be confined primarily to plumage changes succeeding the assumption of postjuvinal plumage. Furthermore, no attempt is made here to describe the color of various other members of this group as this has already been done adequately by both Swarth (1931) and Lack (1945).

No unusual features regarding the arrangement of the pterylae were noted in any of the geospizid studies. Mention may be made, however, of the presence of a rudimentary tenth primary. This has been noted in other fringillids, notably in *Carpodacus mexicanus* by Michener and Michener (1940). As is usual when a distal vestigial primary occurs the corresponding primary covert is lacking. The order of feather replacement follows the general pattern of the postnuptial molt of other passerine birds starting with the loss of the first or innermost primary and ending with the replacement of the sixth or proximal secondary.

There are no apparent secondary sexual differences in color pattern in postjuvinal plumage, although males and females may at times be recognized by differences in behavior. Members of both sexes possess the brownish streaked plumage which is seemingly indistinguishable from that of the adult female. Likewise, no specific differences either in times of molting or in the color of the various plumages of the male were discernible among the species studied.

The postjuvinal plumage appears to be maintained normally for about one year or until the first complete annual molt, hence it is referred to, as the first year plumage.

The phrases "first year plumage" or "postjuvenile plumage" correspond to Dwight's (1900) first winter plumage. The latter term could hardly be used to describe a plumage in birds from the Equator where there is no true winter. The term "normally" is used with some reservation because some of the young that hatched the first year the birds bred in captivity, that is during the summer and autumn of 1940, underwent what was presumed at the time to be a first prenuptial molt in the spring of 1941. A "prenuptial" molt only occurred once in but one of the young hatched in succeeding years and then took place when this individual was one and one-half years old. It was never indicated in the case of adults.

To check with certainty the possibility that a slight first-year prenuptial molt might be overlooked, two young male *Geospiza magnirostris* that had hatched in September, 1943, were partly colored with aniline dyes when in full postjuvenile plumage so that a representative group of feathers of each of the major pteryxae was clearly marked. When the colors faded in the spring of 1944 the feathers were dyed again. No replacements occurred nor were there any additions to the first year plumage up to the time of the first complete annual molt in August, 1944. However, in the spring of 1945 one of these birds again underwent a complete molt. It is possible of course that a few individuals in the native state do undergo a prenuptial molt of some sort. This, however, is certainly not of general occurrence judging from the evidence presented by large numbers of study skins, in the collection of the California Academy of Sciences, representing yearlings as well as second and third year birds in worn plumage taken just prior to and during the normal breeding season.

Those few captive reared males, previously mentioned, that molted the first spring appeared to undergo a complete plumage change including even the flight feathers at this time. The resulting plumage was similar to that usually attained as a result of the first complete annual molt. These same birds again molted completely in the autumn of 1941, some of them assuming full black plumage. These two molts, occurring as they did in the spring and autumn of the year following that in which the young were hatched, seemed to correspond in all respects, aside from the time element, to the first and second complete annual molts as they appeared to occur normally in other young. It seems probable that some factor resulting from their captive environment abnormally speeded up these two molts so that the normal first year plumage was only kept for approximately six months. Following this a partial black plumage was assumed, corresponding to the normal second year plumage. This in turn was molted in about six months so that by the time they were slightly over one year of age they were in a black or nearly black plumage corresponding to that of the normal third year. Following this, however, these same birds reverted to the normal rhythm of but one complete molt a year.

In the other exception mentioned, the young hatched in September, 1943, assumed postjuvenile plumage before November of that year. This was maintained, as was proven by dyeing the feathers, until the fall of 1944 when a complete molt occurred. In the spring of 1945, however, it again molted and acquired the plumage which would not normally have been acquired until the fall of that year. Unfortunately this individual died when the molt was nearly complete.

This brings up the subject of male plumage in *Geospiza* concerning which much confusion has existed. From large series of specimens representing the genus in the Academy collection males of any of the several species, in complete fresh plumage, may be selected showing a complete gradation from the streaked first year plumage, similar to that of the adult female, to a pure black, except for the under tail coverts which always possess a certain amount of buffy edging to them. Some show black

only on the top of the head and the throat, on others it may extend down the neck to include the breast and anterior back. Certain specimens are essentially black with varying amounts of buffy margining to the more posteriorly situated body feathers. Such color gradation often makes it very difficult to segregate certain skins into definite age groups. It does, however, give indication of a large degree of individual variation, the existence of which has been borne out by following the plumage sequence of a number of captive-reared geospizids.

While individual variation is great and in any extensive series of study skins males may be selected showing the complete transition from a female-like plumage to the pure black, nevertheless, most specimens may be allocated to definite plumage stages. This was pointed out long ago by Snodgrass and Heller (1904:273-275) who described six plumage stages distinguishable in male geospizids. It is noted, however, that not all species pass through each of these stages. Members of the genus *Geospiza*, as now understood, are described by these authors as passing through Stages II to VI. These five plumage phases correspond to the juvenal, first, second, third and fourth year plumages described in the present account. The interpretation by Heller and Snodgrass of the significance of these stages, however, is quite different from that presented here. One must presume from their detailed account of *Geospiza fuliginosa* that the changes from Stage II to Stage VI occur within a few months. To quote them (*op. cit.*: 303): "During the time from December to February the males go through Stages III, IV and V, arriving at Stage VI by the first of March." From their further account it appears that their specimens, collected during the months from December to March, had by chance shown progressive plumage stages each succeeding month. It is evident, however, from their comment on the small number of feathers seen growing in at any time and the fact that the darkened feathers are described as brownish rather than black that the specimens studied were in very worn faded plumage which we now know to be normal for members of this group at that time of year on the Galapagos Islands.

As has already been indicated first year plumage is generally replaced completely the year following that in which the young are hatched. This occurred during August and September in captive birds and, judging from museum skins, it takes place between February and June in the Galapagos Islands. Just prior to its replacement the plumage presents a darker appearance, especially on the throat and breast, as a result of the wearing away of a considerable part of the buff-colored tips to the feathers of these parts. In captive birds this condition prevailed from May to July, whereas study skins from the Galapagos Islands taken between January and March often show similar wear.

In second year plumage the feathers on the head and neck of the male are black. Below this they are normally margined with buff, the margins becoming broader and the amount of black more and more reduced on the feathers situated progressively nearer the posterior end of the body. This results in a darkly mottled breast, a lightly mottled belly and an abdomen essentially like that of the first year plumage. The feathers of the back show a similar progressive increase in the extent of the deep buffy margin from anterior to posterior end of the body. There is, of course, a great deal of individual variation in this plumage. Some males show only a slight increase in the amount of black over the first year plumage, while in others it is very extensive. Needless to say it was not found possible to determine the age of females on the basis of color after they assumed first year plumage as this appears to be identical with later plumages.

The second complete annual molt occurs at approximately the same time the following year when the birds are slightly over two years of age. Prior to this molt, however, the males appear considerably darker than they were in fresh second year plumage due to the wearing away of much of the marginal buff on the body feathers. Males

in fresh third year plumage, as a result of the second complete annual molt, possess totally black feathers on the head, neck, breast and anterior back. The feathers of the lower back and rump are usually black, narrowly margined with deep buff and those of the belly and abdomen are black margined with pale buff. As in the preceding plumage the buffy margins are broader on the more posterior body feathers and with wear tend to become progressively reduced. A few individuals in captivity became totally black in third year plumage while others were but slightly darker than the average male in second year plumage. It is highly probable that this same degree of individual variation occurs under natural conditions.

The third complete annual molt in the male results in a fourth year plumage which may be pure black, except of course for the margins of the under tail coverts. Certain individuals, however, exhibited little color change in this plumage from that of the average third year male. In others the amount of buffy tipping was reduced in varying amounts.

It would have been impossible actually to follow the plumage sequence of the male beyond the third year on the basis of study skins alone. Observation of captive birds, however, showed that those individuals which were not totally black by the time they assumed fourth year plumage more nearly approached the total black condition each year thereafter. Some males received in April, 1939, nevertheless, still possessed a few buffy-tipped feathers on the lower abdomen after the completion of the annual molt in the autumn of 1944 and, as has already been explained, others hatched in captivity during the summer of 1940 assumed full black plumage by the time they were one year old, although this is believed to have been abnormal.

Numerous conflicting ideas regarding the black plumage of the male geospizid have been expressed by those who have devoted much time to careful research upon the group. These cannot all be enumerated here but perhaps some of the foremost with which the present writer must necessarily disagree, until definite proof has been shown, may be mentioned. Swarth (1931:24) says that "... with such an absence of streaked males as we find in the series of [*Geospiza*] *acutirostris* from Tower Island, and [*G.*] *debilirostris* from James Island, for example, it seems likely that in those forms the streaked stage is frequently, perhaps almost invariably, not passed through." Again Lack (1945:59) says "On Tower, the proportion of the male *G. magnirostris* and *G. difficilis* in fully black plumage is so high that one can be certain that a large proportion of the males must molt into fully black plumage before they are a year old."

I am of the opinion that such conclusions have been arrived at on the basis of an insufficient number of specimens or because such series as were available did not adequately represent the island populations as a whole. Too little consideration has been given to the matter of seasonal movements and the congregating of various age groups in different portions of any one island. That this occurs is shown by Lack (*op. cit.*: 56) who found that on Chatham and Indefatigable islands, where most of his observations were made, the males breeding near the coast were in streaked or partially black plumage. Those breeding in the intermediate forests were mostly black. Consequently, if collecting were carried on only along the coast or only in the intermediate forests without a knowledge of this seasonal segregation it might easily result in a series of males which would be misleading if considered as representing the male population as a whole.

This point is brought out by Lack in refuting Swarth's contention that there was an exceptionally low proportion of "full-plumaged" males for all species on Abingdon. Swarth based his conclusion on the California Academy of Sciences collection made in 1905, whereas Lack has shown that other collections made in different years have not

borne this out. On the other hand the latter writer agrees with Swarth that inter-island variation exists in the number of males in "black, partial black and in streaked plumage."

The number of streaked or first year males is bound to be far greater toward the end of the breeding season when many of the young of the year are in fresh postjuvenile plumage and the young of the previous year have not as yet lost their worn postjuvenile plumage than would be true at the beginning of the breeding season. Although it cannot be asserted with any degree of certainty, the writer is, nevertheless, of the opinion that even in the genera *Camarhynchus* and *Platyspiza* in which the male appears never to become fully black, several years normally are required before the mature plumage is attained.

That this secondary sexual character of the male to develop a black plumage was once common to the ancestral geospizid stock and is now in process of being lost seems indisputable, as both Swarth and Lack agree. Experimental evidence leads to the conclusion that the production of black plumage is at least partly under hormonal control. This was indicated by the administration of estrogenic hormone to fully black males of *G. fuliginosa* with the result that some of the new feathers that later came in possessed buffy margins, indicating a reversion, to a limited extent, to the partial black plumage.

A number of birds were experimented on with sex hormones but misfortune seemed to befall most of them. It was necessary, consequently, to discontinue this work to avoid depletion of numbers of birds which were required for other purposes. Later the writer hopes to be able to resume this line of research with the same group, including especially those genera in which the male normally becomes black only on the head, neck and upper breast, and with those groups in which the male is not known ever to possess any black plumage.

Captive-reared individuals of both *Geospiza magnirostris* and *G. fuliginosa* were subjected to intramuscular injections of sex hormones primarily in an attempt to cause a reversal in plumage. Males were injected twice weekly with small dosages of α estradiol dipropionate and one female was injected similarly with testosterone propionate. No results were obtained with the female, a two year old *magnirostris*. This individual was first injected on May 26, 1943, and twice weekly thereafter until July 6. Each dose consisted of .03 cc. of testosterone propionate dissolved in sesame oil in proportion of 1.25 mg. per cc. Feathers were plucked from parts of the occipital and nape region on May 28, from parts of the upper breast on June 8, from parts of the crown on June 21, from parts of the upper breast on June 29 and from the crown on July 2. The color pattern of the incoming feathers was readily discernible three weeks after feathers were removed. In no instance was any color change apparent.

Four two-year old males were treated with the α estradiol dipropionate twice weekly. One of these, a *G. magnirostris*, escaped due to a faulty cage ten days after the administration had begun. The other three birds were *G. fuliginosa*. Two of these escaped from the same faulty cage before the opening was detected and the third died before the experiments were completed. However, one of the birds that escaped and the one that died had both shown evidence of slight plumage reversal. Their histories therefore will be given.

Male number 2, as one was designated, was in full black plumage. Between May 28, 1943, and the date of its escape June 21, 1943, it was injected twice weekly with .05 cc. of α estradiol dipropionate in sesame oil (.05 mg. per cc.). A small patch of feathers was removed from the lower back and rump on the day of the first injection. On June 1 a small patch of feathers was plucked from the left side of the breast and another from the belly. On June 8 another patch was removed from the right side of the breast and

on June 21 feathers were again removed from the rump. New rump feathers, replacing those plucked the day of the first injection, were well through their sheaths on June 11 and were definitely black. By June 15 new feathers were quite apparent on the left side of the breast, replacing those black feathers which were removed on June 1. These new feathers, however, possessed narrow buffy margins. The effect of the female hormone on pigmentation in the concentration used was noticeable therefore in feathers replacing those plucked three days after the first administration, although it did not affect those removed the first day. By June 18 it was apparent that new feathers coming in on the right side of the breast, to replace those removed on June 8, were also margined with buffy. The escape of this bird on June 21 was indeed unfortunate.

The other full black-plumaged male in which partial reversal in plumage was effected was designated as number 4. Considerably stronger doses of hormone were given in this instance. Semi-weekly injections of .04 cc. of α estradiol dipropionate (1 mg. per cc. of sesame oil) were given this individual between June 22, 1943, and July 8, 1943, at which time it died. A patch of feathers was removed from the left side of the breast on the first day, June 22, from the right side of the breast on June 29 and from the rump on July 2. By the latter date new feathers were apparent on the left side of the breast replacing those removed the first day. In this instance these feathers showed slightly buffy tips indicating that the effect of the hormone in great concentration is almost immediately noticeable. This individual prior to June 22 had been actively carrying nesting material. At the time of its death, sixteen days later, the testes were small, measuring only 4 mm. in length as contrasted with 7 to 8 mm. for normal, sexually active males.

No attempt was made to administer testosterone to males in either juvenal or first year plumage, just prior to the period of molting, to see if one or more of the intermediate plumage stages might be omitted. Unfortunately by the time these lines of inquiry presented themselves it proved difficult to induce successful breeding and such young as were reared were required in order to follow the normal sequence of molt.

BILL COLOR

Little of a definite nature has been obtained from a study of the bill color of captive birds. Many factors such as changed diet, climate, latitude or perhaps confinement may have been responsible for interference with the normal seasonal change in bill color which is asserted by Swarth (1931:26) to occur among members of this group. Under normal circumstances adult geospizids assume a black bill color during the breeding season, whereas the bill is pinkish yellow during the remainder of the year. Males generally acquire black-colored bills in advance of females, although members of both sexes on occasions have been noted breeding with only partially dark bills. Some juveniles are reported to leave the nest with the bill a light color and others with dark areas appearing on parts of the bill. Certain young develop completely dark bills when slightly over one month in age.

Among captive birds the same variability in regard to the development of the black bill in the young was noted but no regular periodicity correlated with the breeding cycle was apparent among the adults. Most of the males of the four species received in April, 1939, possessed black bills upon their arrival. This black color remained permanently, their bills showing no seasonal change in this regard during subsequent years. A few of the younger males had flesh-colored or yellowish bills which likewise became permanently black within a few months. The majority of the females received in 1939 showed the same tendency as the males. Most of those that possessed black bills on their arrival remained permanently in this state while those that did not, for the most part, soon

acquired the black bill color. Males hatched in captivity, likewise, developed permanently black bills.

A few of the females, both wild-taken and captive-reared, however, showed some indication of a periodic change in bill color throughout the year. In some instances the bill merely changed from black in the spring and summer to horn color in the fall and winter. The bills of a few females became brownish yellow outside of the breeding season and that of one definitely turned a flesh-color except for the distal third which remained black. Several females, likewise, failed ever to acquire a pure black bill, this structure remaining always either a horn color or a brownish yellow.

If the periodic development of black bill color is associated with an increase in gonadal activity as inferred by Swarth (*op. cit.*: 26-27), this may account for the failure of most of the captive birds to show a seasonal lightening of the bill. Most of the males under observation sang throughout the year which would indicate an incomplete recrudescence of the gonads. This seemingly is not of normal occurrence among members of these same species on the Galapagos Islands where even the territorial instinct disappears outside of the breeding season and flocking occurs. Furthermore, some of the captive females also showed signs of sexual activity the year around. Those females that failed to develop a dark bill at any time similarly failed to show any sign of sexual activity throughout the year.

The bills of young birds were either yellowish or flesh colored. This color variation appeared in young of all three species hatched in captivity. It was not confined to either sex and was observed among members of the same brood. The bill sometimes started to darken as early as the fourteenth day after hatching. The change from a flesh-colored or yellow bill to a black bill was gradual, the darkening first becoming apparent just anterior and usually slightly mesial to the nostrils. It then expanded so as to include the entire proximal half of the upper mandible. When the change had progressed this far on the upper mandible, slight indication of darkening was seen at the base of each ramus of the lower mandible. The last part of the upper mandible to become dark was the tip. By the time this occurred all but the distal third of the lower mandible had become dark. The tip of the lower mandible was last to change color.

In those birds that changed from a black to a pale bill after the breeding season the lower mandible was first to lose the black. The black pigment, likewise, disappeared first at the base of the mandible, the tips being last to become pale. That this same sequence of change in color of parts of the bill occurs in the native state was borne out by the bills of wild-taken study specimens in the Academy collection.

REACTION TO DANGER

There are reportedly few natural enemies with which geospizids must contend in the Galapagos Islands. One hawk (*Buteo galapagoensis*) and two owls (*Tyto alba punctatissima* and *Asio flammeus galapagoensis*) are the only raptorial birds endemic to the region. None of these species constitutes an important menace to the smaller land bird populations. No native predatory land mammals occur in the archipelago. From these facts Lack (1945:53) therefore concludes "The Geospizinae would thus seem to have lost the normal reactions of a small bird to predators due to the absence of the latter."

Although one quite logically might assume that a group of birds developed on an isolated insular area where natural enemies are practically non-existent would lose their fear of predators, this was disproven by captive birds in San Francisco. Members of all four of the species studied exhibited alarm at the proximity of local predatory birds. The appearance of the following species was seen to produce this effect on the

caged birds: Red-tailed Hawk (*Buteo jamaicensis*), Cooper Hawk (*Accipiter cooperii*), Sharp-shinned Hawk (*Accipiter striatus*), Sparrow Hawk (*Falco sparverius*), Turkey Vulture (*Cathartes aura*) and Raven (*Corvus corax*). None of these species nor even any representatives of the family Corvidae occurs in the Galapagos Islands. This would indicate that fear of enemies is a very fundamental and deeply rooted response, capable of becoming immediately active in a group of birds in which it probably has been of little use for many hundreds if not thousands of generations.

The captive birds became nervous, ceased singing and emitted loud call notes whenever any predatory species appeared on the horizon. Frequently under these circumstances they would dart into the brushy cover provided them in their cages. So typical was their behavior in the aviary at such times that the writer, whose office was downstairs and a considerable distance away, could invariably tell by their loud call notes when a predatory bird was in the vicinity. Even fledglings would cease calling and assume a crouching attitude. Mounted specimens of hawks and owls similarly aroused considerable fear among the caged birds when placed within their view. When such were placed in their cages they would attempt to hide in brush and remain silent. This tendency to remain silent when they suspected danger to be very close was exhibited another time when a freshly killed Cooper Hawk was placed on the screen roof of the aviary. After the first alarm at the appearance of the hawk the birds remained hidden and noiseless.

CONCLUSIONS

As was stated at the beginning of this paper, the author began this study with some misgivings inasmuch as it was believed that the results would apply essentially to captive birds and have little bearing on the behavior of the same species under natural conditions. Although still firmly convinced that nature's own laboratory is the most ideal one for research in the field of avian behavior, it was revealing to find that there was surprisingly little difference between the reactions and responses of the species studied in captivity and those in the wild state where corresponding types of observations have been made. The dependability of observations made on semi-captive birds has been commented on by Ivor (1944). Birds maintained in captivity, furthermore, may be subjected to experiments which sometimes contribute greatly to an understanding of the more fundamental factors producing the normal pattern of behavior. Many such types of experimentation are impossible in the wild.

The systematic treatment of the geospizids has proven a difficult problem to all who have worked upon the group. One finds that many of the normal rules that apply to most variable groups fail here. Evolutionary development seems to have occurred along a number of divergent lines, more or less at random rather than through active selection. An analysis of geospizid behavior hardly presents fewer problems than those encountered in a systematic study.

The four species which were under observation exhibited great similarity in their actions and reactions. In fact if it were not for differences in body size and in shape of bill it would have been impossible to distinguish them so similar was their behavior. Under natural conditions at least three of these species, *Geospiza scandens* possibly being an exception, show essentially no differences in feeding habits other than those imposed by size. In captivity no distinguishable differences were apparent among any of the four species in this regard. All appeared, likewise, to be identical in courtship behavior and nesting habits. Juvenal song was essentially the same in these species and there was a definite interspecific overlapping in the pattern of adult song as well as great intraspecific variation. It seems probable that, as pointed out by Lack (1945:33) bill recognition is of prime importance in specific identity.

Plumage patterns and sequences were found to be similar in all the species studied. In captivity the males, at the completion of the postjuvenile molt, possessed a female-like plumage which normally was retained for one year. Second year plumage showed black on the head and throat of the male. In third year plumage this black coloration extended down to the breast and the anterior part of the back. Full black plumage was usually attained the fourth year. A great deal of individual variation in the amount of black present in the various male plumages after the first year resulted in some overlapping. That this occurs in the native state is borne out by museum specimens.

Despite the practical absence of native predatory species likely to prey upon small passerine birds in the Galapagos region, captive geospizids showed a definite fear of the avian enemies to which most continental birds of comparable size are usually subject. A high percentage of egg infertility was found to occur in captivity and is also recorded in the wild among geospizids. This may be correlated with the absence of natural enemies.

It would seem highly desirable that further field observations be made on those closely related species of the genus *Geospiza* which occupy nearly identical habitats to determine to what degree interspecific competition exists. It does not seem possible that two or more forms, differing somewhat in structure, but practically identical in habits and occupying the same territory, can avoid competing with each other. If this does not occur, it is probable that some slight yet nevertheless extremely important ecologic differences exist which have not as yet been recognized.

LITERATURE CITED

- Beebe, W.
1924. Galapagos, World's End (G. P. Putnam's Sons, New York), xxi + 443 pp., 422 figs. in text, 8 colored pls., 1 colored frontispiece.
- Dwight, J., Jr.
1900. The sequence of plumages and moults of the passerine birds of New York. *Annals N. Y. Acad. Sci.*, 13:73-360, pls. 1-7.
- Gifford, E. W.
1919. Field notes on the land birds of the Galapagos Islands and of Cocos Island, Costa Rica. *Proc. Calif. Acad. Sci.*, 4th ser., 2:189-258.
- Ivor, H. R.
1944. Bird study and semi-captive birds: the rose-breasted grosbeak. *Wilson Bull.*, 56:91-104.
- Lack, D.
1945. The Galapagos finches (Geospizinae). A study in variation. *Occas. Papers*, 21, Calif. Acad. Sci., viii + 159 pp., 26 figs., 4 pls., 1 map.
- Michener, H., and Michener, J. R.
1940. The molts of house finches of the Pasadena region, California. *Condor*, 42:140-153.
- Snodgrass, R. E., and Heller, E.
1904. Papers from the Hopkins-Stanford Galapagos expedition, 1898-1899, xvi, *Birds. Proc. Wash. Acad. Sci.*, 51:231-372.
- Swarth, H. S.
1929. A new bird family (Geospizidae) from the Galapagos Islands. *Proc. Calif. Acad. Sci.*, ser. 4, 18:29-43, 1 fig. in text.
1931. The avifauna of the Galapagos Islands. *Occas. Papers*, 18, Calif. Acad. Sci.: 1-299, 57 figs. in text, 1 map.
- Tinbergen, N.
1939. On the analysis of social organization among vertebrates, with special reference to birds. *Amer. Midl. Nat.*, 21:210-234, 2 figs. in text.

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VARIATION IN *CARPODACUS PURPUREUS* AND *CARPODACUS CASSINII*

By ALLEN J. DUVAL

In connection with the project of the Fish and Wildlife Service for a study of the birds of the State of Washington I have recently had occasion to examine rather large series of specimens of the two finches, *Carpodacus purpureus* and *Carpodacus cassinii*. The results of these studies were the disclosure of two hitherto unrecognized races, as well as other facts concerning the variation of these birds, which seem worthy of placing on record.

***Carpodacus purpureus rubidus*, new subspecies**

Washington Purple Finch

Type.—Adult male, no. 269192, U. S. Nat. Mus. (Fish and Wildlife Service Collection); Harstine Island, Mason County, Washington, December 10, 1918; collected by George G. Cantwell, original number, 403.

Subspecific characters.—Similar to *Carpodacus purpureus californicus* in size, but darker in both sexes, the male especially, on the head, back, rump, and anterior lower parts; the female usually with a darker olive wash to the upper parts. Lacks the mottled effect of the upper back and nape of *Carpodacus purpureus purpureus*, because of less contrast between feather edges and centers; wing averages smaller.

Measurements (30 ♂♂ and 12 ♀♀ from southern British Columbia, Washington and Oregon).—Male: wing, 76.5-84.0 (av. 79.6) mm.; tail, 56.0-61.8 (58.6); exposed culmen, 11.0-12.5 (11.8); height of bill at base, 8.8-9.5 (9.0); tarsus, 18.0-20.0 (19.0); middle toe without claw, 12.7-14.0 (13.5). Female: wing, 74.0-79.5 (76.3); tail, 53.0-58.0 (55.0); exposed culmen, 11.0-12.0 (11.6); height of bill at base, 8.5-9.3 (8.9); tarsus, 18.0-19.5 (18.6); middle toe without claw, 12.8-14.0 (13.3).

Range.—Southwestern British Columbia, including Vancouver Island, south through Washington, west of the Cascades, to southwestern Oregon (Reston and Brownsboro). Occurs also on the east slopes of the Cascades in Oregon (Friend, Fort Klamath, and near Klamath Falls). Wanders south in winter to southwestern California (Glendora), northwestern Lower California (San Ramon), and west-central Arizona (Fort Verde).

Specimens in fresh fall plumage from Vancouver, Washington, and northern Oregon, stand out very noticeably from *californicus* in the absence of, or reduction in, pale feather edgings of the back, the northern population giving more of a reddish appearance.

No specimens of *rubidus* have been seen from north of central-eastern Vancouver Island, and Laing (Condor, 1942, 44:181) says that birds from the Bella Coola region are intermediate between *californicus* [= *rubidus*] and *purpureus*. This may be the area where the two come together, as typical *purpureus* occurs north and east of there.

A male taken in July at Fort Klamath, Oregon, is intermediate between *rubidus* and *californicus*, while specimens from Humboldt County, California, are typical *californicus*. One winter specimen examined from Fort Verde, Arizona, is *rubidus*, while others from the same locality are *californicus*.

Some indication of the movements of this new purple finch are found in data from the bird-banding returns in the files of the U. S. Fish and Wildlife Service. Lincoln (Tech. Bull. U.S.D.A., 32, 1927:48) records one banded on March 7, 1925, at Pasadena, California, and retaken on June 20, 1925, at Porter, Washington. Another was banded on February 12, 1935, in central California (Modesto) and retaken in May, 1935, at Vancouver, British Columbia; while a bird banded on January 31, 1937, on Vancouver Island (Courtney), British Columbia, was found dead at Independence, Oregon, March 15, 1940.

Palmer (Murrelet, 7, 1926:58) records the purple finch from Puebla, Mexico, but since *purpureus* is not recorded from Mexico, other than northern Lower California, it would appear that this observation was of *cassinii*, for it is known to have occurred in that general region.

Baird (Pac. R. R. Repts., 9, 1858:411, 413), in his original description of *californicus*, did not designate a type specimen, but in the 1860 edition of Baird, Lawrence and Cassin's "Birds of North America," in which plates appear, U. S. Nat. Mus. specimen no. 10230, from Fort Tejon, California, was figured in plate 72, fig. 2, and thus, as Grinnell (Univ. Calif. Publ. Zool., 38, 1932:303) has indicated, that specimen is the type.

Carpodacus cassinii vinifer, new subspecies

Western Cassin Finch

Type.—Adult male, no. 367522, U. S. Nat. Mus. (Fish and Wildlife Service Collection); Swan Lake, Ferry County, Washington, June 17, 1942; collected by Stanley G. Jewett, original number, 1502.

Subspecific characters.—Similar to typical *cassinii*, of the Rocky Mountains, but darker; in males the crown patch crimson to oxblood red, instead of spectrum red to light carmine; the back with more of a purplish (less pinkish) suffusion, the dusky streaking appearing more numerous and darker; the rump of a deeper pink, and the anterior lower parts appearing purplish. The general appearance is more purplish, less pinkish or reddish.

Measurements (14 ♂♂ and 7 ♀♀ from British Columbia and Washington).—Male: wing, 89.5-96.0 (av. 92.8) mm.; tail, 59.5-66.0 (62.5); exposed culmen, 11.8-13.8 (12.8); height of bill at base, 8.8-10.0 (9.3); tarsus, 19.0-20.5 (19.6); middle toe without claw, 14.0-15.5 (14.5). Female: wing, 87.5-91.5 (89.4); tail, 58.5-64.0 (61.7); exposed culmen, 11.5-14.0 (12.8); height of bill at base, 8.8-9.8 (9.3); tarsus, 18.5-19.8 (19.0); middle toe without claw, 13.5-15.0 (14.1).

Range.—Breeds from southwest-central and central-southern British Columbia (Mosher Creek and Okanagan Valley), south through Washington and Oregon, east of the Cascades, to north-central California; and east to southwestern and central Idaho. In winter found spread out over its breeding area from central-southern British Columbia and northeastern Washington southward.

The southern limit of this race has not been determined, as no breeding specimens have been seen from the southern part of its range in California or northern Lower California. Birds from northern California show a trend away from the British Columbia-Washington population, as the crown patch is not as dark. It may be that birds from central and southern California are the same as the birds from Nevada. The Great Basin birds from Nevada, while placed with *cassinii*, are the lightest of any examined.

The breeding range of true *cassinii* then, as now understood, is from northwestern Wyoming, west to central-northern Utah and western Nevada, south to southern Nevada, north-central Arizona, and central-northern New Mexico, and east to central-southern Colorado (Rio Grande), and central-southern and northeastern Wyoming. Winters over most of its breeding range from east-central Wyoming (Converse County), north-central Colorado, and west-central Nevada, south through Arizona and New Mexico to Coahuila (Sierra Guadalupe), San Luis Potosi (Charcas) and the Valley of Mexico. Occurs as a straggler in northwestern Nebraska (Crawford and Monroe Canyon). McLellan (Proc. Calif. Acad. Sci., ser. 4, 15, 1926:306) lists a specimen taken on May 16, on Maria Madre of the Tres Marias Islands, and there is in the United States National Museum collection a worn male specimen taken in the pine forest at Mirador, Vera Cruz, in June, 1864, by C. Sartorius, which apparently represents the southern limit for this species; whether or not it represents a breeding bird or is just a wanderer is not certain.

No specimens have been seen from western Montana and northern Idaho to determine the form there.

Baird's description of *Carpodacus cassinii* was based on two male specimens taken at Camp 104, Pueblo Creek, New Mexico [= 10 miles E Gemini Peak, Arizona] on January 22, 1854, and one female taken about 75 miles west of Albuquerque, New Mexico, on November 15, 1853. Since a full description was given of a male, and since

Pueblo Creek was listed first, Pueblo Creek, Arizona, is hereby designated as the restricted type locality. Male no. 6421, U. S. National Museum, is selected as the type because the other male, no. 6420, from the same locality, was sent to the Buenos Aires Museum in April of 1872, and perhaps is not now extant.

Although careful study of specimens bears out the knowledge of many observers in the field that the Cassin and Purple finches are two distinct species, they are obviously so closely related and approach one another in appearance so markedly that an analysis of their morphological points of difference and similarity seems warranted.

Ridgway (U. S. Nat. Mus. Bull. 50, pt. 1, 1901:126) gives size of wing and exposed culmen as the main distinguishing characters, and in the present study the wing was found to be the constant which served to distinguish the two definitely, although the tail usually was also a good criterion. Male *cassinii* has a wing which, in 51 examples, was never less than 89 mm., and averaged 92.5 mm., whereas the male of *purpureus* has a wing not more than 87 mm., in 94 examples, with average of 80.8 mm. As can be seen from these figures there is no overlap in wing measurements between the maximum of the smaller and the minimum of the larger, and there is approximately 12 mm. difference in the averages. One female specimen, however, from the Deschutes National Forest, Lake County, south-central Oregon, while like *cassinii* in color, is the smallest specimen of that species seen, and in the wing is just above the maximum measurements of typical *purpureus* from the eastern United States (83.8 mm.); the tail is typical of *purpureus* (55 mm.). The bill is also more like the *purpureus* group. This exceptionally small individual might have been considered an intergrade between the species *purpureus* and *cassinii* if it were not for the fact that in color it shows no indication of intermediacy; also, others from the same region are typical of *cassinii*.

It has been generally assumed that *cassinii* possessed a relatively large bill, and on gross examination of a few examples, as well as in average measurements, this was found to be true, but when a large series of the two was examined it was found that there was considerable overlap, *purpureus* having a maximum of 12.5 mm., and *cassinii* a minimum of 11.0 mm., in the males. This indicates that *cassinii* is not consistently a "big-billed" bird, and that the bill size alone is insufficient for specific determination.

The following tables show the size range and averages of the two species and their races as now understood from this study:

		Male				
Subspecies	Number of specimens	Wing	Tail	Exposed culmen	Height of bill at base	
<i>C. p. californicus</i>	28	75.5-83.0 (79.4)	55.0-61.3 (58.8)	10.3-12.5 (11.4)	8.1-9.5 (8.9)	
<i>C. p. rubidus</i>	30	76.5-84.0 (79.6)	56.0-61.8 (58.6)	11.0-12.5 (11.8)	8.8-9.5 (9.0)	
<i>C. p. purpureus</i>	36	80.0-87.0 (82.8)	54.5-61.5 (58.5)	10.0-11.8 (10.8)	8.3-9.5 (8.9)	
<i>C. c. cassinii</i>	10	89.5-95.0 (92.8)	60.5-68.0 (63.5)	11.0-13.0 (12.6)	8.5-9.5 (9.1)	
<i>C. c. vinifer</i>	14	89.5-96.0 (92.8)	59.5-66.0 (62.5)	11.8-13.8 (12.8)	8.8-10.0 (9.3)	
		Female				
Subspecies	Number of specimens	Wing	Tail	Exposed culmen	Height of bill at base	
<i>C. p. californicus</i>	14	74.0-79.0 (77.5)	54.0-60.0 (57.1)	10.5-12.0 (11.4)	8.5-9.5 (9.0)	
<i>C. p. rubidus</i>	12	74.0-79.5 (76.3)	53.0-58.0 (55.0)	11.0-12.0 (11.6)	8.5-9.3 (8.9)	
<i>C. p. purpureus</i>	12	79.0-83.0 (80.6)	55.0-60.5 (57.3)	10.0-11.8 (10.8)	8.5-9.0 (8.9)	
<i>C. c. cassinii</i>	12	87.0-93.0 (89.7)	59.0-63.5 (61.4)	11.5-13.0 (12.3)	8.8-10.0 (9.3)	
<i>C. c. vinifer</i>	7	87.5-91.5 (89.4)	58.5-64.0 (61.7)	11.5-14.0 (12.8)	8.8-9.8 (9.3)	

In plumage the male Cassin Finch has the back and scapulars vinaceous or pinkish vinaceous mixed with grayish, with dark conspicuous streaks which give this finch more of a brownish gray appearance. Males of *purpureus* have the back and scapulars reddish or purplish brown, with centers of feathers forming darker streaks, but no birds

with such heavily streaked backs, as in *cassinii*, have been examined. Below the pinkish or wine color extends well down on the breast, sides and flanks, while in *cassinii* it is not as extensive; also the color of the breast in the male *cassinii* is paler than the crown, whereas in *purpureus* it is nearly the same color.

Females of *cassinii* almost always lack the olive green characteristic of the upper surface of *purpureus*, although some examples of *purpureus* lack the olivaceous and are as grayish as *cassinii*. Only an occasional specimen of *cassinii* shows a faint tinge of olive in the lower back and rump. Below, the dusky streakings of *cassinii* are more cuneate or narrowly wedge shaped, while in *purpureus* they are deltoid or broader, giving a noticeably finer streaked appearance in *cassinii*.

The juvenal plumage is very markedly different, in that *cassinii* is much paler (light grayish brown) and the streaks fuscous on the under parts rather than rusty brown both above and below, as in *purpureus*.

Thus it can be seen that the Cassin Finch shows no overlap in wing measurement or color pattern in relation to the Purple Finch, even in areas where the two species breed very close together in British Columbia, Oregon, and California.

For the loan of invaluable material used in this study to supplement the material in the United States National Museum, appreciation is expressed to Dr. Alden H. Miller, of the Museum of Vertebrate Zoology, University of California, and to Mr. Stanley G. Jewett and Mr. James A. Munro.

Fish and Wildlife Service, United States Department of the Interior, Washington, D.C., July 14, 1945.

CALIFORNIA JAYS, THEIR STORAGE AND RECOVERY OF FOOD, AND OBSERVATIONS AT ONE NEST

By HAROLD MICHENER and JOSEPHINE R. MICHENER

During the fall of 1943, two California Jays (*Aphelocoma californica*) were busy gathering English walnuts from a large tree on a lot adjacent to our home in Pasadena. They hid many of them in the deep ground cover of leaves on our lot; some were hidden entire and others were opened and partly eaten, the remainder being stored. With the smaller pieces, and also with sunflower seeds and pieces of bread, the hiding was often accomplished by placing them directly in loose ground. When an object was to be hidden, it was held in the beak and thrust downward and forward under the leaves or into the ground. If the going was hard, the object was sometimes hammered with the closed beak or taken to another place. When hammering, the whole effort seemed to be directed definitely toward getting the object out of sight and not toward opening the nut or sunflower seed as stated by Amadon as a probability with the Florida Jay (*Aphelocoma coerulescens*) (Amer. Mus. Nov., No. 1252, 1944:3). After thrusting the object to an apparently satisfactory position a clod of dirt, a rock, or a leaf, or more than one of these, was usually placed over it.

The fact that, while raking leaves over a small part of the yard, we found 16 walnuts without any effort to look for them, substantiates the conclusion that large numbers were hidden by the jays, a conclusion already reached by observations of their considerable carrying and burying activities.

Do jays recover the food that they hide in this way? That they do not recover all of it was surprisingly evident one spring after the jays had had free access to the box of chicken feed which contained a liberal admixture of sunflower seeds. Sunflower plants came up all over the block. On the other hand even casual observations convince one that they recover a part of the food hidden, the amount probably depending to some extent upon their need to draw upon that supply. Also, observations make it easy to conclude that they remember, or know in some way, where at least some of the food has been hidden.

During the winter, one, and probably both, of the two individuals mentioned above was seen to alight on an extensive pile of leaves, look around deliberately, take a few hops, throw aside a few leaves, look around again, take a few hops to another spot and again throw aside a few leaves. On one such occasion half a walnut was uncovered on the third trial, all three trials being made within a circle of three-foot diameter. On another occasion ten trials were made within a fifteen-foot circle before a nut was found. In another instance grass was being removed from a thick growth of low ground-cover plants. A jay came looking about among the plants four feet from the worker. It was thought to be looking for insects that had been disturbed. It picked up a eucalyptus seed pod and threw it aside. After repeating this three times within a small area, it picked up a part of a walnut in the shell, carried it about fifteen feet away and hid it in a pile of leaves.

These jays opened the English walnuts at various places in the yard, such as in the gutter of the garage roof or beside a garden hose lying on the ground, in which case the nut was placed on the ground and against the hose while the bird stood on the hose with one foot close on each side of the nut, holding the nut if need be. But the favorite cracking "anvil" was in the low, nearly horizontal branches of a shrub where three branches, two of them with forks, lay side by side in a manner that formed a secure

resting place for a walnut and a perch above. Here, standing with both feet on the perch, the jay could hold the nut with one foot (see fig. 33). The nut was turned to the right position with the beak, held with the foot against further turning, and hammered a few times with the beak. Then it was turned again, held and hammered. This was continued until the shell was opened. The nut was struck on the line of cleavage between the two

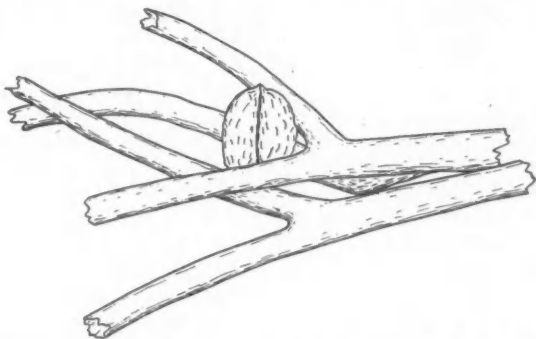


Fig. 33. California Jay's "anvil" on which English walnuts were cracked.

halves. About two quarts of shells were gathered from the ground beneath this anvil in February and many more accumulated there during the following month. So many nuts have been hammered on this anvil that the bark of the four branches against which the nuts rest shows considerable wear. The observations on this "anvil" of the California Jay recall the "chopping block" of the Lewis Woodpecker reported upon by J. Eugene Law (Condor, 31, 1929:233-238).

Herbert L. Stoddard in his book "The Bobwhite Quail" suggests that the Blue Jay (*Cyanocitta cristata*) in a measure balances its injury to the quail's eggs and young by opening nuts and scattering about parts of the kernels. This distribution of food was observed at the anvil of the California Jays. White-crowned Sparrows, Spotted Towhees, House Finches and Plain Titmice were seen to feed on pieces of nut found on the ground below the anvil. The titmice, above all others, seemed to be aware that the jay was opening a nut. One was seen to begin to scold from the bush just above the anvil almost as soon as the *whack, whack, whack* of the jay's beak on the nut began. The scolding and watching continued until the jay went away with a large piece of kernel, leaving the remainder on the anvil. The titmouse was down at the anvil in an instant but only had a peck or two at the nut before a Spotted Towhee flew in from a distance of about 20 feet, scared the titmouse away and knocked the nut to the ground with its first peck. Then it flew away. The titmouse came back to the ground and took a piece of the nut up to a low perch where it held the nutshell with its feet and ate a couple of pieces of kernel. Then the jay came back and the titmouse flew away, dropping the piece of nut, but was back again looking around as soon as the jay went away.

About March 12 these jays were seen pulling fibers out of an old door mat and carrying them away, evidently for nest lining. On March 18 the female (?) was seen to have an injured foot. Previous to this the male (?) was seen to give food to the female on several occasions. On April 10, about mid-morning, they were seen to be carrying twigs to a multiple crotch about 20 feet up in a rather open *Pittosporum* shrub of about 25

feet total height. There were only a few twigs in place when first observed. Both birds were breaking dead twigs off some guava bushes about 50 feet away and carrying them to the nest. Apparently both birds placed twigs in the nest, but poor visibility and the fact that the birds were not conspicuously marked prevented definite determination of this. The female's injured foot had improved so much that it no longer served as a ready means of distinguishing her from the male. They were still gathering twigs at 7:00 p.m. (P.W.T.). These observations led to the belief that this pair of jays was lining a nest on March 12, that about March 18 something happened that stopped activities at the nest and injured one foot of the female, and that on April 10 they began to build another nest.

By mid-morning of April 11 the nest was a well-formed open-mesh basket which, from the ground, appeared to be about eight inches across the top and five inches deep. At noon on that day they were seen gathering branchlets from dead asparagus fern which hung from the lower part of the nest tree. On April 12 they were seen gathering fibers from the old door mat. They had been seen taking dead twigs from guava, *Cassia*, *Pittosporum*, and Chinese elm, but, so far as seen, had taken nothing from the ground except fibers from the old door mat. Twigs dropped to the ground as they were broken off were not retrieved. They were not seen to try to break off living twigs.

During a little more than an hour of watching in mid-afternoon of the 13th they came to and left the nest four times, but whether they carried nest material could not be seen. However, while at the nest, they moved about as if working on it. They were not watched steadily on the 14th and 15th but were seen or heard at the nest several times each day. In going to and from the nest the birds stayed quite close together. One sometimes would remain at the nest a few moments after the other had left. Watching the nest was so unsatisfactory, because of the obstructing foliage, that it was given up.

The male jay became more and more domineering toward the other birds in the yard, including the Chinese Spotted Doves. He would chase them away from the food shelf and vicinity and would apparently try to keep them away. The food shelf was about 70 feet from the nest. House Finches (*Carpodacus mexicanus*) nesting in the next yard were heard several times giving their distress notes and on May 5 the jay was seen to kill a fledged House Finch on the ground under the jay-nest tree. After pecking it vigorously he flew with it in his beak for about 10 feet where he dropped it, apparently accidentally, since he was back immediately within two or three feet of the observer who stood over the House Finch while it gave its final wing-beats. The jay talked in its conversational way and continued to do so for a few minutes after the House Finch was taken away. The next day a trap was set and baited with sunflower seeds. The jays apparently paid no attention to it, which was strange, for jays usually cannot resist sunflower seeds. On May 7 a hen's egg with a small hole in the shell was put in the trap. Early in the afternoon the male jay was in the trap and was killed. No calling was heard from the female. The next morning she was busy, evidently feeding and brooding young in the nest. It is not known when they were hatched. She seemed to be getting along very well and had no time to bother other birds. Everything seemed peaceful among the birds in the yard.

During a watch of 4 hours and 11 minutes, from 10:05 a.m. to 2:16 p.m., she completed 23 on-off cycles of an average duration of 10.9 minutes (24 maximum and 3 minimum). The on periods averaged 7.2 minutes (18 maximum and 1 minimum) and the off periods averaged 3.8 minutes (6 maximum and 2 minimum). The weather was dull and dark with a high fog and a temperature of about 60° F.

On the next day, May 9, she completed 12 *on-off* cycles in 3 hours (10:30 a.m. to 1:30 p.m.) with an average duration of 15 minutes (21 maximum and 9 minimum). The *on* periods averaged 10.25 minutes (16 maximum and 1 minimum) and the *off* periods averaged 4.75 minutes (8 maximum and 2 minimum). The weather was cloudy with a light mist which had loaded all the shrubbery with water but which stopped about the time the observations were begun.

The foliage screened the nest site so that only the general position of the bird at the nest could be seen. When she went to the nest, she stood, apparently on the rim of the nest, with head and tail bobbing up and down, for as much as a minute sometimes, and then settled down into the nest. She was not observed sufficiently while off the nest to obtain a comprehensive idea of the food that she was eating or carrying to the young. She was several times seen to take bread; at one of these times nut-meats, sunflower seeds and a broken egg were nearby. At other times she was also seen to take nut-meats.

On May 10 the jay was seen to be going to and from the nest and to the food trays but was not watched much. Early in the afternoon another jay was calling nearby. In mid-afternoon it was seen about two feet from the nest. Because it showed more blue than the female, it was judged to be a male. There was no major disturbance in the nest tree during the afternoon. No calling had been heard since the male of the pair was killed except two short series at about 6 a.m. on May 10.

On May 11 there was no unusual calling near the nest tree during the morning. Observations were not begun until 12:15 p.m. No jay was seen near the nest until 2:10 when one came to the nest and bobbed head and tail as if feeding young or pecking into the nest. In a few minutes another flew into the tree from the north and the first one flew out to the south. The second hopped around a bit and left to the north. At 2:35 one flew into the tree from the northeast, perched about three feet from the nest for a minute or two and then left to the north. At 2:47 two jays flew into the tree and there was considerable fluttering and fighting in the vicinity of the nest for a few seconds. After a few minutes one flew to the north and the other perched a short distance above and to one side of the nest. A little later one flew south past the tree and upon investigation two jays were heard "talking" on the south side of the fence, perhaps 20 feet from the nest tree. At 4:30 two recently killed young jays were found on the ground about 100 feet from the nest. One of them had lost its head and one leg. The primary pinfeathers were about three-eighths of an inch long and the body feather tracts were dark and rough but the pinfeathers were not really coming through yet.

There was considerable calling on the 12th and 13th. Either the female that owned the nest had moved away or she had changed her pattern of actions so that she was no longer recognized. Occasionally a jay came to the nest tree but soon departed. The one that was thought to be the one that broke up the nest life occasionally took high perches within the area not over 100 feet from the nest, with more or less bobbing and with some calling as he went to and from those perches.

During the afternoon of the 13th, in rather close succession, a jay twice went to the nest. For a minute or two it was apparently standing on the rim of the nest. Its tail, the only part visible, was flipping up and down as if it were pecking into the nest. At each visit, as it left through the branches of the tree on the opposite side from the observers, it seemed to be carrying something that hindered its movements. The two observers came to this conclusion independently from different locations in one instance.

It is concluded that the female, deprived of her mate, cared for the young successfully from the afternoon of May 7 to the afternoon of May 10. By that time, another male discovered that the territory was not being protected by a male, moved in, and

found the nest. By noon of May 11 the female had stopped attending the young, although in mid-afternoon she fought with the intruding jay in the nest tree for a few seconds. By 4:30 that afternoon the young jays had been killed and two of them carried and dropped 100 feet away from the nest. During the afternoon of May 13 a jay twice took a dead young from the nest and carried it away. During the 32 days from April 10 to May 11, inclusive, the nest was built, the eggs laid, incubated and hatched, and the young had reached the stage of having primary pinfeathers three-eighths inch long.

Pasadena, California, June 24, 1945.

NOTES ON SOME AMERICAN SHOREBIRDS

By BOARDMAN CONOVER

In connection with some other work it recently became necessary to check the identifications of the specimens of American shorebirds in the Chicago Natural History Museum. In doing this an investigation of the validity of a number of races was made. Believing that some of the findings might be of interest to others, they have been written up and are presented herewith.

For the loan of specimens I am indebted to the American Museum of Natural History, New York, the Colorado Museum of Natural History, Denver, the Museum of Comparative Zoology, Cambridge, the Louisiana State University, Baton Rouge, the Museum of the University of Kansas, Lawrence, the Museum of Zoology of the University of Oklahoma, the Academy of Natural Sciences of Philadelphia, the United States Fish and Wildlife Service and the United States National Museum, Washington.

Jacana spinosa violacea Cory

Parra violacea Cory, Bull. Nutt. Ornith. Club, 6, 1881:130—Haiti, type from Gantier.

A comparison of the two series of adults (including the type) listed below fails to show any constant distinguishing characters for the birds from the Greater Antilles. The coloration of both the upper and under parts varies in the same degree in both lots, and any example from the West Indies can be matched by one from Central America. The variation in the size of the lappets is the same in both and undoubtedly is influenced by the proximity of the breeding season.

The name *violacea* therefore should be dropped and the range of the typical race *spinosa* extended to include the Greater Antilles. As a matter of fact, beginning with his "Birds of Haiti and San Domingo" published in 1885, Cory himself put this name into synonymy.

Material examined.—Greater Antilles, 27: Cuba (Isle of Pines, 5; Cabanas, 5; Palacios, 3; Oriente, 1); Dominican Republic (Lake Enriquilla, 2; Lake of Rincon, 1; San Domingo, 1); Haiti (Gantier, 1; Lake Assuei, 3; Etang Saumatre, 1; Mivagoane, 1; Fort Liberty, 2); Jamaica (Hodges, Long Pond, 1).

Central America, 49: Mexico (Tamaulipas, 1; Cruz, Tamaulipas, 1; Tampico, 19; Apatzingan, Michoacan, 1; Matamoras, Campeche, 1; Yucatan, 1; San Felipe, Yucatan, 2); Guatemala (Istapa, Santa Rosa, 4; Quezaltenango, 1; Peten, 1); El Salvador (San Sebastian, La Paz, 4); Nicaragua (Grenada, 1); Costa Rica (Puntarenas, 2; Limon, Limon, 3; Bebedero, Guanacaste, 2; Ballina, Guanacaste, 1); Panamá (Bocas del Toro, 2; Cricamola, Bocas del Toro, 2).

Jacana spinosa intermedia Sclater

Parra intermedia Sclater, Proc. Zool. Soc. London, 1856 (1857):282—Venezuela.

As its name suggests, this form is intermediate between the maroon-backed *J. s. melanopygia* and the lighter-backed *J. s. jacana*. Among the Venezuelan specimens examined, the ones from the country lying between the eastern base of the Andes and the state of Carabobo are the darkest, while those from the state of Sucre and the Orinoco are lighter dorsally and often very like *J. s. jacana*. Examples from just east of the Andes in Colombia, however, are the darkest of all, one from Morelia being indistinguishable from some examples of *melanopygia*. It is probable that this dark maroon-backed phase extends south through eastern Ecuador to connect with the very similarly colored *peruviana* of eastern Peru.

Material examined.—Venezuela, 19: Maracay, Aragua, 4; Lake Valencia, Aragua, 1; El Cuji, Lara, 1; Duaca, Lara, 1; Valencia Carabobo, 2; Guanoco, Sucre, 2; San Antonio, Sucre, 3; Altigracia, 3; Sacupana, Orinoco Delta, 2.

Colombia, 5; Morelia, Caqueta, 4; Belen, 4.

Charadrius alexandrinus nivosus Cassin

Aegialitis nivosus Cassin, in Rept. Expl. Surv. R. R. Pac., 9, 1858:696—Presidio, California.

An examination of specimens from eastern Colorado, Kansas, Oklahoma and the Gulf coast west of Florida shows that birds from these localities do not differ in coloration from a series taken in California, examples in comparable plumage being identical. Several of the Oklahoma specimens, it is true, are rather light, but their plumage is worn and shows evidence of extreme fading, due probably to the type of ground on which they were nesting.

The range of this race therefore should be extended east to Alabama.

Material examined.—Colorado, 7: Barr Lake, Adams County, 1; Eads, Kiowa County, 6.

Kansas, 3: Stafford County, 1; Ashland, Clark County, 2.

Oklahoma, 9: Cimarron River, 1; unspecified, 1; Greer County, 3; Cherokee, 3; Edith, 1.

Texas, 17: Frijole, 3; Corpus Christi, 3; Port Aransas, 3; Port Isabel, 2; Port Lavaca, 3; Rockport, 2; Aransas County, 1.

Louisiana, 11: Cameron, Cameron Parish, 5; East Timbalier Island, Lafourche Parish, 4; Creole, Cameron Parish, 1; Grand Isle, Jeff Davis Parish, 1.

Mississippi, 4: Horn Island, 1; Deer Island, 2; Gulfport, 1.

Alabama, 1: Dauphine Island, 1.

California, 115: various localities.

Charadrius alexandrinus tenuirostris Lawrence

Aegialitis tenuirostris Lawrence, Ann. Lyc. Nat. Hist. N. Y., 7, 1862:455—Near Guantanamo, Cuba.

A comparison of the specimens listed below with a large series from California and Utah raises grave doubts as to whether this race is worthy of recognition and leads me to believe that the supposed lighter coloration of *tenuirostris* is due entirely to wear and fading. Unfortunately no specimens from the type locality, Cuba, seem available in this country. Those examined from other islands in the West Indies leave much to be desired, as none is in fresh, unworn breeding plumage. Practically all of them can be matched, however, by examples from California in the collection of the Chicago Natural History Museum. In the Florida series, two of the specimens are dark and similar to birds in corresponding plumage from California. The rest are rather light colored, some (including the one from Yucatan, Mexico) being a grayish white. All these lighter birds, however, are very worn and show extreme fading, due probably to local conditions.

Specimens from the West Indies in fresh, unfaded breeding plumage are badly needed to settle this question.

Material examined.—West Indies, 18: Bahama Islands (Great Inagua, 3; Grand Turk Island, 1; Grand Caicos, 2; Crooked Island, 2; Fortuna Island, 2); Haiti (Etang Bois Neuf, St. Marc, 1; Lake Assuei, 1); Puerto Rico (Cabo Rojo Light, 5); Virgin Islands (St. Croix, 1).

Florida, 21: Mary Esther, 9; St. Andrew, 1; Santa Rosa Island, 7; East Pass, 2; Big Pass, 2.

Mexico, 1: Yucatan (Rio Lagartos, 1).

Charadrius wilsonius rufinucha Ridgway

Aegialitis Wilsonius var. *rufinucha* Ridgway, Am. Nat., 8, 1874:109—Spanishtown, Jamaica.

Ridgway, although the describer of this race, omits it from his "Birds of North and Middle America," so he must have later changed his mind and thought it unworthy of recognition. Peters (Bull. Mus. Comp. Zool., 61, 1917:403; Auk, 44, 1927:535) believes it is separable, stating that West Indian birds are darker than those from the mainland. Wetmore (Bull. U. S. Nat. Mus., 155, 1931:148) agrees with this, but states that specimens seem to fade after a few years, and only fairly recently taken ones show the darker coloration.

The West Indian series listed below was taken between the months of March and July, as early as 1900 and as late as 1937. Comparison of them with Texas and Florida birds taken from 1896 to 1923 does not show that there is any difference in coloration.

In fact the darkest specimens are April ones from Texas and a March one from Matamoros, Mexico, taken in 1916 and 1912, respectively.

Material examined.—West Indies, 48: Bahama Islands (Great Inagua, 5; Andros, 5; Mariguana, 5; Aklin, 2; Great Bahama, 2; Eleuthera, 4; Green Turtle Cay, 1); Cuba (Cabanias, 4; Mariel, 1); Haiti (Gran Boucan, 1; Aquin, 2; Etan Saumatre, 2); Puerto Rico (Cabo Rojo Lighthouse, 1); Virgin Islands (St. Croix, 5; Virgin Gorda, 2; Anegada, 5); Lesser Antilles (Little Saba, 1).

North America, 38: Virginia (Northampton County, 2); North Carolina (Dare County, 7); South Carolina (Charleston County, 1); Florida (Nassau County, 6; Brevard County, 4); Texas (Corpus Christi, 8; Port O'Connor, 4; Cameron County, 4); Mexico (Matamoros, Tamaulipas, 2).

Charadrius wilsonius cinnamominus Ridgway

Pagolla wilsonia cinnamomina Ridgway, Bull. U. S. Nat. Mus., No. 50, pt. 8, 1919:108 (in key), 113—Sabanilla, Colombia.

Two specimens in the United States National Museum taken on the island of Mustique are referable to this race. My thanks are due to Mr. James Bond of the Academy of Natural Sciences of Philadelphia for calling my attention to this fact.

Arenaria interpres morinella Linnaeus

Tringa Morinella Linnaeus, Syst. Nat., ed. 12, 1, 1766:249—sea coast of North America; restricted type locality, coast of Georgia, *ex* Catesby.

The characters of this race are evident only in the breeding plumage and have been given as: (1) upper parts more reddish, (2) crown of head lighter, with dusky markings less in evidence.

The specimens listed below were taken from April to July and most of them are in good nuptial plumage. Examination of this series shows that in the American birds both the males and females are redder than the like sex from Europe and Asia. Alaskan birds, however, are rather puzzling. The four specimens from Hooper Bay are very red, the ones from Barrow and Chipp River not quite so ruddy, while the other mainland specimens are either like typical *interpres* or intermediate. Both sexes also have the crowns dark as in examples of the typical race, but this character is often found in birds from the east coast and even more often in those from the interior. Alaskan specimens, therefore, as a whole are intermediate and it would seem best to classify all the ruddy turnstones from the American mainland under *morinella* as in the latest A.O.U. Check-list (see also Grinnell and Miller, Pac. Coast Avif. No. 27, 1944:147), rather than list the western Alaskan and Pacific coast birds under the typical race, as is done by Peters and Ridgway. It should be mentioned here that the two specimens listed from Chile are both males and have the upperparts very reddish.

The examples available from the islands in Bering Sea and the Aleutians are not in very high plumage, but as far as they can be judged appear to belong to the typical race rather than to *morinella*.

Greenland material was very unsatisfactory. Two east-coast males and a female seem more like European birds, while a female from west Greenland resembles American specimens. All, however, are somewhat worn and leave much to be desired.

Material examined.—*Arenaria interpres interpres*, 53: Greenland (east coast, 3; west coast, 1); Iceland (unspecified, 1); Faroe Islands (unspecified, 1); Norway (unspecified, 2); Sweden (Stockholm, 1; Oland, 1); Holland (unspecified, 1); France (Havre, 1); England (Pagharn Harbor, 2; Orkney Islands, 1); British Somaliland (unspecified, 1); Siam (Ban Hiañ, 2); China (Fukien, 8); Siberia (Gizhiga, 2); Japan (Yokosha, 1; Hakodate, 2; Hondo, 4; Sagami Province, 1; Yokohama, 2; Shimosa, 1); Bonin Islands (unspecified, 1); Bering Island, 6; St. Lawrence Island, 1; Pribilof Islands (St. Paul, 1; St. George, 1); Hall Island, 1; Unalaska, 3.

Arenaria interpres morinella, 80: Alaska (Barrow, 4; Chipp River, near Barrow, 8; Wainwright, 2; Cape Lisbourne, 1; Coal Land, 1; Wales, 2; Nome, 1; Nulato, 1; Kotlik, 1; Hooper Bay, Bering Sea, 4; Carbon Creek, 1; Port Clarence, 1); Washington (Grays Harbor, 2); California (Eureka, 1);

Texas (Seadrift, 1); Saskatchewan (Lake Johnston, 1); North Dakota (Towner County, 3; Ramsey County, 3; Nelson County, 4); Illinois (Cook County, 5); Massachusetts (Chatham, 1); Connecticut (Stamford, 1; Norwalk, 1); New York (Suffolk County, 2; Cayuga County, 4); North Carolina, Dare County (Pea Island, 17; Bodie Island, 1); Bahama Islands, 2; Jamaica, 1; Aruba, 1; Chile (Atacama, 2).

Erolia alpina pacifica Coues

Pelidna pacifica Coues, Proc. Acad. Nat. Sci. Phila., 11, 1861:189—west coast of North America.

Examination of a practically topotypical series of thirty-four specimens of *Erolia alpina sakhalina* taken at Gizhiga at the north end of the sea of Okhotsk proves that Thayer and Bangs (New Eng. Zool. Club, 5, 1914:17) and Bishop (Condor, 40, 1938:225) were correct in claiming that the name *pacifica* should be used for the American race. These east Asian examples were all taken in May and are in fresh breeding dress. While there is a great variation in this series, the upperparts average much lighter, more buffy, less reddish than American specimens in similar plumage. Whereas some sixty odd examples from North America are almost all orange reddish above with only an occasional dark buffy specimen (one from Alaska is light buffy), thirteen of the Asian series have the upperparts light buffy, eight have these parts orange red, and the remaining thirteen have the dorsal surface orange buff intermediate between the buffy and orange red extremes. In a few other Asiatic specimens examined, one from Anadyr, Siberia, has the upperparts orange buff, while six others from Siberia south to China are orange reddish above.

Typical *alpina* from Europe (type locality Lapland) is dark buffy above. Two spring specimens in the author's collection taken at Tomsk, Siberia, agree in coloration, bill curvature, etc., with the light buffy-backed specimens from Gizhiga. It would seem quite possible that *sakhalina* may be simply an intermediate between a dark reddish-backed race (*pacifica*) from North America and a light buffy one (*centralis*?) from central Asia, and perhaps not worthy of recognition.

No difference could be seen in the markings of the lower throat and chest in the two series as claimed by the above-cited authors, but the bills in the American birds are more curved and average longer.

Material examined.—*Erolia a. alpina*, 3: Iceland (unspecified, 1); Finland (Pasvik, 1); Italy (Fano, 1).

Erolia a. pacifica, 66: Alaska (Hooper Bay, 3; Nome, 1); California (Monterey, 4; Alviso, 1; Nigger Slough, Los Angeles County, 3); North Dakota (Walsh County, 2; Towner County, 3); Minnesota (Heron Lake, 2); Wisconsin (Beaver Dam, 2); Illinois (Calumet Lake, 1; Chicago, 1); Michigan (Alpena County, 1); Massachusetts (Chatham, 3); New York (Cayuga Lake, 5); Virginia (Cobb's Island, 1; Cape Charles, 6); North Carolina (Pea Island, 19); South Carolina (Mt. Pleasant, 5; Copahoe Sound, 2); Florida (Amelia Island, 1).

Erolia a. sakhalina, 41: Siberia (Amur Bay, 2; Anadyr, 1; Gizhiga, Sea of Okhotsk, 34); Corea (Chemulpo, 1); Japan (Shimosa, 2); China (Fukien, 1).

Erolia a. centralis?, 3: Siberia (Tomsk, 2; Tschikischljär, Transcaspia, 1).

Chicago Museum of Natural History, Chicago, Illinois, June 11, 1945.

FROM FIELD AND STUDY

Tennessee Warblers in Marin County, California.—An unusually heavy migration of warblers occurred during the fall of 1944 through Marin County, California, and the water traps nearest our warbler aviary at Manor produced a number of surprises, not the least of which were four examples of the Tennessee Warbler (*Vermivora peregrina*). The first bird was taken on the morning of September 16, 1944. Not being familiar with this eastern species, it was banded and placed in a holding cage pending identification, which was subsequently accomplished without difficulty. Other Tennessee Warblers were seen in shrubbery adjacent to the aviaries on the same and subsequent days, and another individual was trapped on September 19. A third Tennessee Warbler was taken on September 24, and although others were occasionally seen on the grounds in the following fortnight, the fourth individual was not caught until October 15.

Because of the rarity of the species in California, it was determined to keep all four birds for aviary purposes. Much to our surprise, we found this species to be among the easiest of the whole warbler group to "break off," a term used for the technique of weaning captive birds from a natural to an artificial diet.

These warblers were carried over the winter in a separate aviary compartment in the large heated shelter and were not released into the warbler aviary proper until late April of this year. At the date of this writing they are showing signs of an early summer molt, not an unusual occurrence with adult migrants trapped in the preceding fall and wintered over in heated quarters. They are very much like our Orange-crowned Warblers (*Vermivora celata*) both in action and behavior, and this is particularly noticeable under the conditions imposed by the aviary.

Upon death, they will be made into skins to complete the record.—ERIC CAMPBELL KINSEY, Manor, Marin County, California, June 6, 1945.

Nesting of the Goshawk in Sequoia National Park, California.—On June 20, 1945, Ranger Clarence Fry told me about a Goshawk (*Accipiter gentilis*) that had that morning swooped at his car when he parked near the government corrals near Giant Forest, Sequoia National Park. The place is in the upper Transition life-zone. The next morning Fry and I visited the corrals and were again attacked by a female Goshawk that charged savagely near us several times before she flew away. I soon discovered the nest about 60 feet up and 6 feet out on a limb of a white fir. By going up the side of the mountain one could almost see into the nest but could not quite do so because of some fresh fir twigs on the edge of the platform. Neither eggs nor young birds could be seen.

On June 27, when I again visited the nest, three downy young birds of noticeably different sizes could be seen wabbling about on the platform. The parents were calling near-by and the female parent was seen to fly away with unidentified prey in her talons. The nest was visited almost daily for short periods thereafter until July 12, when most of the day was spent observing it. On these visits the identified prey brought to the nest comprised a golden-mantled ground squirrel (*Citellus lateralis*), a Red-shafted Flicker (*Colaptes cafer*), and a Steller Jay (*Cyanocitta stelleri*). Once as the female was perched about 30 feet above me she was seen to fly swiftly into the thick branches of a near-by fir about 40 feet above the ground. After a few seconds, during which her wings could be heard beating against the small branches, she emerged with a squirming Sierra chipmunk (*Eutamias speciosus*) dangling from her talons. Twenty minutes later she brought the prey to the nest. She made no sound as she tore the chipmunk into pieces for the squealing young birds as they avidly pecked at the mother's beak for bits of the freshly killed mammal. The old bird was not frightened and did not stop feeding the young birds as I walked or stood in plain sight less than 75 feet away. The meal lasted for 35 minutes, after which the old bird flew away and perched in the top of a dead tree. After the meal each of the young birds was seen to back to the edge of the platform and forcefully defecate beyond the edge of the nest.

The two largest of the young birds left the nest some time between July 26 and July 28. Mr. Wayne Trimm, who made a study and several paintings of this Goshawk family, found the smallest of the young birds dead beneath the tree on July 29.

This nest is a new southern record for the Goshawk in California. The most southerly nesting station recorded heretofore was found in Whitaker's Forest, Tulare County, according to Grinnell and Miller (*The Distribution of the Birds of California*, 1944:97). The nest described here is some 10 miles south of Whitaker's Forest.—LLOYD G. INGLES, Fresno State College, Fresno, California, August 2, 1945.

Land Birds at Sea.—In the late autumn of 1943 I saw four species of North American land birds at unusual distances from land. I was aboard a ship steaming northward along the Pacific coast.

A Cooper Hawk (*Accipiter cooperii*) was seen at 4:25 p.m. on September 21, flying near the ship at 35° 13' N, 122° 06' W. Nearest land was Point Piedras Blancas, California, out of sight 48 miles northeast. The hawk seemed tired and once alighted in the ship's rigging. Later it was flying near five Sooty Shearwaters. Sunset this day occurred about 2½ hours later. The weather was clear and warm with no wind.

Two Short-eared Owls (*Asio flammeus*) were seen at 57° 24' N, 150° 10' W. From this position the nearest land was Kodiak Island, 70 miles northwest. The owls were sighted at dawn on October 13 in an overcast sky with occasional mists. They stayed with the ship, occasionally alighting on deck, and did not leave until long after we had sighted land. I was able to walk up to one and to handle it, during which process it did not offer resistance or make any noise.

A flock of about eight Audubon Warblers (*Dendroica auduboni*) accompanied the ship northward for about half an hour at 8:30 a.m. on October 8 at 44° 10' N, 124° 40' W. Occasionally they alighted on deck. Nearest land was Cape Perpetua, Oregon, out of sight 25 miles east. Weather was foggy and windless, with a glassy sea.

With the flock of warblers were two Oregon Juncos (*Junco oreganus*). They were comparatively tame, permitting me within 3 feet; they foraged within 5 feet of passers-by. They remained in the vicinity of sacks of coal and potatoes, in the lee of the amidships superstructure. They were fed bread crumbs and water by the crew, but they also foraged on the sacks and drank condensed water vapor drops from the breather-pipes of the sanitary system. They remained aboard the next day, although land was clearly visible about 10 miles away. One was roosting that night in a crevice between sacks. It was seen the next morning in the same place until 6 a.m. That day the wind blew strongly all day and we were 60 miles south of the Queen Charlotte Islands.

On October 11 one was seen for the last time at the sack pile, its feathers fluffed in the rain. We were at the time 50 miles west of Graham Island. I believe that this bird was the same one which boarded us three days before; it rode northward 557 miles at a time when it should have been migrating southward.—JOHN A. GRAY, JR., Lt. (j.g.), U.S.N.R., June 14, 1945.

Does the Russet-backed Thrush Have Defective Eyesight?—When, during migration seasons, reports have been received of birds killing or maiming themselves by flying against glass windows or doors, at least 90 per cent of the victims identified by me have proved to be Russet-backed Thrushes (*Hylocichla ustulata ustulata*). As this species is by no means our most common migrant in southern California, some physiological deficiency appears to be indicated. The most natural assumption would be that the eyesight of the bird functions inefficiently, but that, of course, cannot be proved without further study.—G. WILLETT, Los Angeles County Museum, Los Angeles, California, June 16, 1945.

California Gulls Feeding on Midges.—Though the California Gull (*Larus californicus*) has almost the status of a State bird in Utah in return for its help to Mormon pioneers in controlling the cricket plague of 1848, the bird is becoming over-abundant in Salt Lake and Utah valleys, where it is a menace to certain types of agricultural pursuits. This gull is well known as an omnivorous feeder: the greater the competition for food, the greater becomes the range of foods consumed. Cherry growers have complained that the gulls, knocking the cherries off the trees, destroy a good portion of the crop. On the other hand, where ground squirrels and prairie dogs are abundant, these birds are frequently observed following the road, feeding on animals hit by speeding motorists. On June 17, 1945, a California Gull picked up and swallowed a crippled chipmunk on the road near the divide of the Wasatch Mountains between Logan and Brigham.

Although the California Gull is well known to be a scavenger, it is a common experience in the West to see flocks of these birds following the plow and avidly consuming insect larvae, earthworms and other animal life that is exposed. They also commonly feed on the immature or emerging adult salt flies (*Ephidra*) that occur in great numbers in the salty waters of Great Salt Lake. Crippled ducks or other birds, especially those incapacitated by botulism, are readily preyed upon.

On June 19, 1945, some 2500 of these gulls fed in a flock following a 50- to 70-yard swath in the sagebrush and grass on the north end of Strawberry Lake, Wasatch County, Utah. Close observation revealed that they were feeding almost entirely on a large species of midge (chironomid) that had just emerged from the lake. In the areas where the birds had been feeding, fully 95 per cent of the insects had been consumed; on adjacent areas where the birds had not yet foraged, the insects were so thick as to form a cloud. Many of the insects were in the air; many more were attached to blades of grass and sagebrush. This emergence of the chironomid insects also caused a large concentration of Brewer Blackbirds (*Euphagus cyanocephalus*) and Vesper Sparrows (*Poocetes gramineus*).—CLARENCE COTTAM, United States Fish and Wildlife Service, Chicago, Illinois, August 10, 1945.

A Record of the Snowy Owl in Southern California.—Mr. William G. Ritter, of Palmdale, California, has in his collection a mounted specimen of the Snowy Owl (fig. 34), of which he writes me on May 2, 1945, as follows: "I was on a fishing trip back of Mt. Baldy in May of 1913 when a fellow sportsman told me of the different Owl he had seen in an old abandoned mine shack near Baldy. He said it was ill or hurt, but was so ferocious he wasn't able to touch it. I hiked up and found the bird with a mutilated wing. I brought it home but couldn't do anything with it so chloroformed and mounted it." The exact location, as nearly as Mr. Ritter can now place it, is at



Fig. 34. Specimen of Snowy Owl taken near Mount San Antonio, Los Angeles County, California.

an elevation of approximately 7000 feet, about eight miles northwest of Mount San Antonio, at a place shown on the U.S.G.S. San Antonio quadrangle as "Big Horn Mine." The site is therefore in Los Angeles County. The southernmost California records for this species admitted by Grinnell and Miller, *Pac. Coast Avif.* No. 27, 1944:198) are Santa Cruz County along the coast and Butte County in the interior. They characterize the San Diego County record cited by Bent (*U. S. Nat. Mus., Bull.* 170, 1938:374) as "unsubstantiated."—R. M. BOND, *Soil Conservation Service, Portland, Oregon, June 15, 1945.*

Further Records of Birds from Central California.—The ornithological collection of the late O. P. Silliman contains several specimens of birds that constitute records of distributional significance and which previously have not been made known. Most of these have come to notice in the course of checking identifications preparatory to cataloguing the collection in the Museum of Vertebrate Zoology. The specimens here mentioned were not taken into consideration in "The Distribution of the Birds of California" (*Pac. Coast Avif.* No. 27, 1944), which was in process of publication when the Silliman Collection was received. All comments which follow regarding ranges are made in reference to the accounts contained in this recent publication.

Puffinus tenuirostris. Slender-billed Shearwater. One (*Mus. Vert. Zool.* no. 91142) taken on April 1, 1915, at Santa Cruz, California, by A. G. Vrooman is the first authentic record of this species in the spring in California waters; previously it had been reported from mid-September to the end of Janu-

ary. An earlier report for April 10, on Monterey Bay (Grinnell, *Pac. Coast Avif.* No. 11, 1915:27) is an error.

Oceanodroma homochroa. Ashy Petrel. It has been suspected that this species occurs along the California coast throughout the year, but winter records between November 16 and April 8 have been lacking. One such is now at hand—a waif (no. 91163) taken at Salinas, Monterey County, on February 2, 1937, by R. L. Rudd.

Butorides virescens anthonyi. Green Heron. Winter records for central California are few. To these may be added one from Santa Cruz on December 15, 1895, a bird of the year (no. 91172) taken by A. G. Vrooman.

Dendrocygna bicolor fulva. Fulvous Tree-duck. Winter records for this duck are particularly unexpected in coastal central California. A male (no. 91192) was taken on February 24, 1899, in the vicinity of Santa Cruz, apparently by Vrooman.

Mergus merganser americanus. Common Merganser. A group of four immature birds (nos. 91255-91258) of this species was taken on July 11, 1937, at the De Tracey Ranch, 900 feet, Nacimiento River, San Luis Obispo County, by Jack C. von Bloeker, Jr., and R. L. Rudd. All possess stubby-ended rectrix shafts typical of immature ducks, and all were flightless due to the incomplete growth of the remiges. It seems certain that these ducks were hatched near by in the Nacimiento River system, a circumstance of which the collectors were fully aware. There is no other record of the breeding of this merganser in the coast ranges south of San Francisco Bay. The southernmost coastal breeding station heretofore recorded is the Navarro River, Mendocino County.

Sphyrapicus thyroideus nataliae. Williamson Sapsucker. The occurrence of the Williamson Sapsucker in winter at low elevations toward the seacoast is unusual. Even more unexpected is the presence there of the Rocky Mountain race *nataliae*, a subspecies which has been but recently added to the California state list. In the Vrooman material is a male (no. 91905) that is thoroughly typical of the race *nataliae*; it has an extremely small, slender bill. The bird was taken on November 29, 1896, in Santa Cruz County, probably near the town of Santa Cruz. This specimen is apparently the basis for McGregor's report (*Pac. Coast Avif.* No. 2, 1901:8) of the Williamson Sapsucker at Santa Cruz. At the time, races of this species were not recognized, and the record has subsequently been assumed, incorrectly, to pertain to *S. t. thyroideus*.

Guiraca caerulea salicarius. Blue Grosbeak. The coastal region of California between Ventura County and San Francisco Bay is sparsely visited by Blue Grosbeaks and none is certainly known to have bred in this area. That the species does breed scatteringly or sporadically in this section is made seem more likely by records of birds (nos. 92505, 92506) taken by R. L. Rudd $2\frac{1}{2}$ miles northwest of Soledad Mission, Monterey County, in the Salinas Valley, on June 20, 1938, and May 7, 1939.

Loxia curvirostra. Red Crossbill. Few verifiable occurrences of the race *L. c. sitkensis* south of the San Francisco Bay region in California are on record. Two small birds (nos. 92652, 92653), typical of this race, were taken on February 19, 1899, at Seabright, Santa Cruz County; the male is yellow colored. Much less to be expected in the Santa Cruz region are members of the race *L. c. bentii*. A male and a female (nos. 92654, 92655) taken at Glenwood, Santa Cruz County, on December 27, 1891, by C. B. Badger, show characteristic size and bill shape of this race; the male is typically light rosy red. No records of this race have heretofore been noted in the coastal sections of California. The breeding range lies to the eastward in the Rocky Mountains.

Amphispiza belli nevadensis. Bell Sparrow. An example (no. 92767) of the race *nevadensis* taken at Los Baños, Merced County, on February 5, 1936, by R. H. Beck, extends northwestward from Fresno County the known winter range of this race in the San Joaquin Valley.

Junco oreganus pinosus. Oregon Junco. Two juncos (nos. 92810, 92811) taken on July 7 and 8, 1937, at San Ardo, 450 feet, Monterey County, seem to indicate a breeding station for the race *pinosus* in the floor of the middle section of the Salinas Valley; one of the birds was molting. This is an unexpected local extension of the breeding range of this race which nests commonly at higher elevations in the mountains on either side of the valley.

Spizella atrogularis cana. Black-chinned Sparrow. A male (no. 92825) taken on October 9, 1937, at Priest Valley, Monterey County, by Jack C. von Bloeker, Jr., belongs to the race *cana* rather than to the form *cawina* which nests in the mountains of San Benito County a few miles to the northward. Probably this example of *cana* was a vagrant from the south or east. Autumnal records for any race of this species in California are scarce.

Zonotrichia querula. Harris Sparrow. An additional record of this rare winter visitant in California is that of a bird (no. 92826) taken near Davenport, Santa Cruz County, on November 23, 1902.—ALDEN H. MILLER, *Museum of Vertebrate Zoology, Berkeley, California, August 15, 1945.*

Starlings Wintering in Southern Texas.—Previous reports of the Starling (*Sturnus vulgaris*) have recorded its spreading to new localities and indicated increases in numbers in New Mexico and Texas (Condor, 42, 1940:86; 43, 1941:197; 44, 1942:182; 45, 1943:161).

During the past winter, counts were made of flocks of Starlings when they happened to be noted adjacent to roadways on various occasions in Jim Wells and Nueces counties, Texas. No special effort was made to observe these birds and the counts evidently represent only a small portion of the total number of Starlings present. The counts were as follows:

December 8, 1944—Alice, Texas	18
January 19, 1945—Alice to Corpus Christi, Texas (4 flocks of 100, 25, 40, 250)	415
January 30, 1945—Near Agua Dulce, Texas	300
January 30, 1945—Agua Dulce to Bishop, Texas (4 flocks of 600, 275, 400, 70)	1,345
February 2, 1945—7 miles northeast of Alice	200
February 3, 1945—2 miles north of Alice	25
February 6, 1945—None noted on isolated ranch or vicinity in brushy range country 10 miles northwest of San Diego, Texas	
February 7, 1945—5 miles northwest of Bishop with Boat-tailed Grackles and blackbirds	300
February 16, 1945—Near Bishop	20
March 2, 1945—2 miles east of Bluntzer, Texas	2
Total	2,625

No Starlings were noted at any of the above places after March 2 and apparently these birds were only winter visitants as it was evident they had gone elsewhere for the breeding season. Size of future populations and their effects on production of sorghums for grain in this area will be of interest and details should be recorded.—CLARENCE A. SOOTER, *Alice, Texas, June 6, 1945.*

Winter Record of Red-winged Blackbirds at Grand Canyon, Arizona.—At about five o'clock on the afternoon of December 13, 1943, I discovered a blackbird feeding on the straw mulch in my back yard, an area free of snow. The twitching tail was a quick reminder that the bird was not a Brewer Blackbird and soon the orange-red epaulet showed. Then a streaked female was found feeding with the male. These birds were watched for about fifteen minutes when a Sharp-shinned Hawk (*Accipiter striatus*) suddenly dropped out of the pine tree above them and struck and started to carry off the male bird. Pounding on the window frightened the hawk enough so that it dropped the bird. The next day the female fed all day but no male put in an appearance. Again on December 15 the female was seen for a short time and then no more.

Both Redwings seemed very hungry and worked hard culling grain from the straw. This record is the first for the South Rim of the Grand Canyon and merits special attention because of the presence of both sexes at 7000 feet in a piñon-juniper association in the middle of winter. The only other record for Grand Canyon National Park is based on a female taken on September 15, 1928, at the North Rim Checking Station, where attractive meadows are present.—HAROLD C. BRYANT, *Grand Canyon, Arizona, July 26, 1945.*

Breeding of the Green Heron in Northwestern Oregon.—On May 25, 1944, Joe Eckley of Portland, Oregon, found a well-grown fledgling Green Heron (*Butorides virescens anthonyi*) wandering along a well traveled boulevard in southeast Portland near what is locally known as the "Oaks Slough," a swampy section of bottomland bordering the Willamette River. This area is subject to inundation at the time of spring floods and is kept fairly well watered the rest of the year by several natural springs flowing through it. In addition to several small tracts of tules there are clumps of willows here and there over the tract. There are numerous summer records of the occurrence of this little heron along both the lower Columbia and Willamette rivers, but to date no nests have been reported as found. Mr. Eckley kept the young heron a few days, after which it died. The specimen was given to me and I prepared it as a study skin. The taking of this fledgling gives us the first definite breeding record for the species in Oregon.—STANLEY G. JEWETT, *Portland, Oregon, May 10, 1945.*

Autumnal Occurrence of a Mountain White-crowned Sparrow.—The Mountain White-crowned Sparrow usually migrates southward along the east side of the Sierra Nevada of California and is seldom seen in the coastal section of the state. At Big Bear Lake in the San Bernardino Mountains, Mrs. Kent and I had a feeding tray at our cottage, and among many Gambel Sparrows (*Zonotrichia leucophrys gambelii*) there appeared on October 3, 1944, one Mountain White-crowned Sparrow (evidently *Zonotrichia leucophrys oriantha*). We observed it closely with our Bausch and Lomb binoculars on three consecutive days, after which it did not return again.—W. A. KENT, *Los Angeles, California, June 10, 1945.*

NOTES AND NEWS

On August 2, 1945, death came to George Willett, leader and warm personal friend of a host of bird students. In human affairs, as in science, his wisdom and good nature exerted a strong and helpful influence, which will be sorely missed. The Cooper Club counted on him heavily and profited immeasurably from his unselfish devotion to its welfare. He was Secretary of the Cooper Club Corporation and Vice-president of the American Ornithologists' Union, but these positions reflect only a small part of his activity in behalf of ornithology. His extensive field work and his writings will later be recounted in the pages of *The Condor*.—A.H.M.

Volume 5 of Peters' "Check-list of the Birds of the World" made its welcome appearance on the Editor's desk on August 27, 1945. The high esteem in which this work is held perhaps needs no elaboration, but it at least deserves repetition. This volume covers the hummingbirds, trogons, kingfishers, motmots, and horned bills, among others, and thus carries the treatment through the Coraciiformes.

According to a letter recently received by R. T. Orr, David Lack will become Director of the Edward Grey Institute of Field Ornithology in Great Britain on October 1, 1945.

During the past three years there has been increased use of the organic chemical DDT for the control of insects responsible for sickness and discomfort in the Armed Forces. This has been so successful that experimental beginnings have been made to determine its value for control of crop and forest insects. Up to now, little knowledge is available as to what harm may be done to wildlife should DDT be applied on a large scale, but plans have been formulated by the United States Fish and Wildlife Service to obtain needed information. Although preliminary studies seem to indicate that few, if any, birds and mammals are likely to be killed by DDT itself, indirect harm may come through reduction in insect-food supplies, especially when applications are made shortly before or during the nesting season. Under forest conditions a single low-concentration application (in oil) for prolonged periods has continued to kill insects that have come in contact with the minute crystals that form after the solvent has evaporated, thus bringing about a prolonged reduction in the total insect population.

Mrs. Amelia Sanborn Allen had an important role in bird study in the San Francisco area for more than forty years. Her death on February 15, 1945, took from the Cooper Club a member with one of the longest records of field activity centered in Berkeley. Her parents moved from New Hampshire to Minnesota and then to Missouri where Amelia Sanborn was born at Winsor on December 29, 1874. The family moved to California in 1888. In the period which followed Amelia was graduated from Pomona College in its second class and then taught school. On several occasions she had opportunity to develop an interest in birds, but failed to respond to any of them.

Within a year after Mrs. Allen came to Berkeley, as the wife of James T. Allen who became Professor of Greek in the University, the writings of Torrey and Keeler aroused her to recognize the presence of birds and the opportunities for interest in them. Progress was slow, as it generally is for a person working alone and without help. It was not until the summer of 1903 when the Allens went to vacation in the mountains with Professor and Mrs. Charles R. Keyes that she finally got on the path to learning birds. By the next summer she had identified 102 species. By 1912 this list reached 132, and in 1921 she had come to know 148 kinds of land birds.

An important event for Mrs. Allen was the coming of Joseph Grinnell to Berkeley in 1908 and the opening of the Museum of Vertebrate Zoology. The Cooper Club began regular meetings here with ladies welcome. At last, there were numerous persons to share the enthusiasm of making discoveries in the field. In 1911 the Allens moved to a permanent location on the hillside south of Strawberry Canyon and adjacent to the University Campus. Here an intimate acquaintance with the neighboring birds was soon developed which was carried on with few interruptions for more than thirty years. A series of observations was published in the *Condor*, including two long reports, one in 1915 and one making comparisons and summary in 1943. Many groups of persons came to visit and to glimpse the assemblage of birds. Besides the Cooper Club numerous classes in ornithology were given this special treat.

The visit to the Allen home by the Northern Division on New Year's morning 1921 was reported editorially in the *Condor*, as follows: "The occasion was a pleasant one socially, and in addition there was an ornithological feature of remarkable interest. The bird feeding table

just outside the large plate window of the dining room where breakfast was served to the human guests was continually patronized by numerous avian visitors. These latter represented some ten or more species—thrashers, thrushes, wren-tits, towhees, etc.—all wild birds, behaving normally. The differential lighting on the two sides of the window, darker within than without, doubtless in part accounted for the charming obliviousness of the birds. Within, the considerable company of people was able to observe the birds closely under most comfortable conditions, even to comment upon them freely in ordinary conversational pitch of voice, without alarming or distracting the principals in the nature play being acted outside."

As an outgrowth of observations made at this window, Mrs. Allen began to band birds with bands received in May 1918 from H. H. Cleaves. She then became the first bander in California. Her own account of this early banding, as published in 1922 (*Univ. Calif. Chronicle*, p. 102) included the following information. "The first bird to be marked in this way was a Brown Towhee, which was accidentally caught February 11, 1919. Since that time his mark of identification is easily seen as he feeds on the table, and he is never missing. The next bird to be banded was a Fox Sparrow which was caught in a basement room, March 29, 1919. He migrated with his kind to Alaska soon after, but returned to his winter boarding place November 3, 1919. On April 24, 1920, he started on his second summer trip to Alaska and returned safely again on November 7, 1920. Two Golden-crowned Sparrows were likewise banded March 3, 1920, made their summer journeys to Alaska, where they raise their young, and returned, one on October 23, the other November 15, 1920, and one again on October 25, 1921." It is no wonder that she concluded that "surprises are certainly in store for those who undertake to do the trapping and banding."

The field course in natural history given at the University by Dr. Harold C. Bryant was attended by Mrs. Allen in 1913, and like others she received new inspiration from it. Later she conducted field groups of her own and these were joined by women whose concern with birds soon grew beyond the casual stage. Her first trip by special aptitude for detecting and analyzing bird sounds was employed to instill permanent interest. Her first trip by automobile was made in May, 1916. This brought many new localities within range of study, but her chief interest remained in the home surroundings. After 1919 she made trips and longer visits to Boulder Creek, in the Santa Cruz Mountains, an important secondary base for study. The next year Mrs. Allen began to prepare the Season Report on the San

Francisco Region for Bird-Lore. Through 1936 she assembled eight-two of these reports and she continued to supply information for subsequent ones through the remainder of her life. This work gave her a thorough acquaintance with the status of every species in the area.

The Cooper Club History written by Swarth traces the record of Mrs. Allen in the club, as follows: "Early in the history of the Northern Division one or two women were elected to membership at different times. On rare occasions they attended meetings, but the atmosphere was evidently not congenial and feminine memberships at that period did not last long. But times have changed! Mrs. Amelia S. Allen was elected to membership in 1913, and was elected secretary of the Northern Division in 1916. For eight years she remained in this arduous and thankless position, giving such secretarial service as the Northern Division had never had before. No wonder that the termination of this period called for a year of rest abroad! Upon her return in 1925, Mrs. Allen was elected vice-president, and in 1926, president, in recognition of her notable contribution to the Club's welfare, the first woman to hold such office in either Division."

In the minutes of the Northern Division meeting on January 24, 1924, at the termination of her long term as secretary, it is recorded that Mr. Swarth called attention to that service and remarked that "doubtless Mrs. Allen would be surprised to learn that the Cooper Club had for once carried through a piece of business without either her knowledge or her help." She was then presented with a pair of high-grade six-power binoculars and two books: Dresser's Manual of Palaearctic Birds, and Ramsay's Guide to the Birds of Europe and North Africa. These were for use in her contemplated year of bird study in the Old World. An extended report on these experiences was presented at the regular meeting for August, 1926. Three of these trips to Europe, in 1905-1906, 1924, and 1937, brought her many new experiences and an intimate acquaintance with birds of Europe, especially in the South.

Bird students in the San Francisco area have become accustomed to help and to be helped by others of like interests, but among them all none has contributed to the welfare of the group in so many ways and for so long a period as has Mrs. Allen. Her willingness to share knowledge and experience is not likely to be replaced soon.—
JEAN M. LINSDALE.

PUBLICATIONS REVIEWED

"The Family Anatidae," by Jean Delacour and Ernst Mayr (*Wilson Bull.*, 57, 1945:3-55), is a very timely review of the ducks of the world.

As it will have a great influence on the future arrangement of the families and species, a careful estimate of the changes proposed should be in order.

These changes are quite revolutionary and are based for the most part not on structure but on color patterns of adults and downies and especially on affinities in courtship and display. No one can be better qualified than the senior author in regard to the latter owing to his unrivaled opportunities with the many species which he has kept in captivity.

One structural character is regarded as fundamental, the scutellation or reticulation of the front of the tarsus. Mainly on this character the family is divided into two subfamilies, Anserinae and Anatinae; the former, besides the swans and true geese, includes the *Dendrocygnini*, the latter all the rest of the ducks plus many "geese" formerly classed with the Anserinae, such as *Chloëphaga*, *Cyanochen*, and *Alopochen*.

This seems a sound arrangement; the "patterned" downies of these genera are very different from the plain downies of true geese and swans. On the other hand, the just as distinctly patterned downies of *Dendrocygna* are taken from the ducks and placed with the geese and swans.

One biological trait which the authors place a great value on is the carrying of the young on the back of the parents; this is regarded as being peculiar to the swans, but many ducks have the same habit. Many observers must have seen a merganser with two or three downies on her back while the rest of her brood were streaming in a tail behind.

Genera are murdered in good, hearty fashion. In regard to the surface-feeding "tribe," Anatinae, everything is included under *Anas* except *Hymenolaimus*, *Malacorhynchus*, *Stictonetta*, and *Rhodessa*. This "all or none" treatment is warrantable and the close relationships of the blue-winged group, the Cinnamon, Garganey, and Blue-winged teals, with the Shovelers are correctly interpreted.

But the authors cannot have seen the Blue-duck, *Hymenolaimus*, with its unique, forward-looking eyes and peculiar habits in life; nor are the spherical eggs of *Rhodessa* taken into consideration.

The subfamily Anatinae is divided into "tribes." These are not in accordance with any previous arrangement.

Tribe 1. Tardorni. Sheldrakes. Besides the sheldrakes, the Egyptian, Orinoco, Abyssinian and South American "geese" are included; also the Crested Duck formerly included in the restricted genus *Anas*. The Cape Barren Goose and steamer ducks are added as "aberrant species."

Tribe 2. Anatinae. River ducks.

Tribe 3. Aythyini. Pochards. This is a natural

group and nearly all will concur with the reduction of genera to two, *Netta* and *Aythya*. The inclusion of the Rosy-billed Duck and the Southern Pochard in *Netta* may be objected to by some; the females of these are far more like *Aythya* than *Netta* in life. The statement that the Ring-necked Duck and the Tufted Duck are closely related is undoubtedly based on the superficial resemblance of the males; the females are very different, while the downies are so different that they must be placed definitely at opposite ends of the genus.

Tribe 4. Carinini. Perching ducks. This is a new group and probably a sound one. It includes genera that formerly had no acknowledged relationships, *Chenonetta*, *Aix*, *Nettapus*, *Sarkidiornis*, *Plectropterus* and *Carina*, the last including *Pteronetta* and *Asarcornis*. The Brazilian Teal is removed from the Anatinae and included here in the revived genus *Amazonetta*.

Tribe 5. Mergini. Sea ducks. This includes, besides the mergansers, the genera *Somateria*, *Melanitta*, *Histrionicus*, *Clangula*, and *Bucephala*, all of which have undoubted affinities. A strong point is that all take two years to mature; another is that mergansers and golden-eyes readily hybridize. But exception should be taken to the claim that none of these have speculums; these are present in both the Harlequin and Steller eiders; conversely, the Anatinae are described as always possessing speculums; the gadwalls have none. In the opinion of this reviewer the scoters are not a "very compact group"; the Old World Black Scoter and the American Scoter are distinctly different from the others in life and courting actions; the tracheas and voices are also widely divergent. The downy of the Hooded Merganser does not resemble those of the others of the group; the eggs are also different from the others, including those of the Smew.

Tribe 6. Oxyurini. Stiff-tailed ducks. These ducks form a very distinct and homogeneous group and should be placed in a separate subfamily.

Tribe 7. Merganettini. Torrent ducks. More investigation is required to place these curious ducks.

In the summary at the end of the paper many questions are discussed. Not much stress is placed on the eclipse of males and no mention at all is made of the eclipse of females. Interesting facts are recorded regarding fertility and sterility of hybrids; and the final note is a plea for further research both in the biology of the family and their anatomy, to which we can all subscribe.—ALLAN BROOKS.

David Lack's study of "The Galapagos Finches (Geospizinae)" (Calif. Acad. Sci. Occ. Paper no. 21, 1945:viii + 158 pp., 1 map, 26 figs., 4 pls.)

contributes importantly to the fields of breeding behavior, ecology, and speciation. Since the time of Darwin, who discovered them, this group of finches, endemic to the Galapagos Archipelago off the coast of Ecuador, has been investigated by a series of distinguished students—Ridgway, Rothschild and Hartert, Snodgrass and Heller, Gifford, Lowe, Sushkin, Swarth, and others. But a modern interpretation of the specific relationships of the Geospizinae, stressing biology rather than taxonomy, has been needed.

New data offered by Lack are based, first, on field studies on four of the Galapagos Islands, but mainly Indefatigable, from mid-December, 1938, to early April, 1939, and second, on statistical studies of extensive collections of geospizids in American and British museums. The latest comprehensive systematic review, that of Swarth, is followed by Lack; most of the taxonomic changes made by the latter author are simplifications. The group Geospizinae consists of thirteen species and six genera; one monotypic genus, *Pinaroloxias*, occurs on Cocos Island, about 500 miles northeast of the Galapagos.

The main chapters deal with breeding behavior, ecology, coloration, variations in bill and wing, and general evolutionary problems. Indifference of the finches to human presence and individual differences in plumage, bill, and song enabled the author and his aid, W. H. Thompson, to observe the birds closely. "The breeding cycle follows a typical territorial passerine pattern" (p. 20). "Breeding habits of the different genera and species . . . are extremely similar" (p. 37). "Breeding habits have been far more conservative than food habits in the evolution of the Geospizinae" (p. 133). "Plumage characters have been much more conservative in evolution than size and shape of bill" (p. 134). But "many bill differences, especially those between closely related species, cannot be correlated with food differences" (p. 133). "Birds have not reached the Galapagos Islands via a land bridge. . . . The species of Geospizinae are not as sharply defined as in mainland birds, but they do not show the degree of overlapping or of hybridization sometimes claimed for them, and there is no need to assume for them some quite exceptional method of evolution" (p. 135).

Lack's efforts, and those of the editors, necessitated by wartime circumstances, in preparing the manuscript for publication, have resulted in a major contribution meriting careful study. A number of problems and questions are posed by Lack's stimulating discussions of this unusual group of birds; the exceptional opportunities which they afford would more than compensate for another extended period of field study. "Further collecting is needed to establish the position of some forms" (p. 6). "Attempts to cross-breed

the birds in aviaries on the Galapagos failed" (p. 1). Since Lack's "visit did not cover the non-breeding period," more observations, especially on feeding and flocking, are needed. The same applies to the biology of species claimed to have identical or similar ecological requirements.—FRANK A. PITELKA.

MINUTES OF COOPER CLUB MEETINGS

NORTHERN DIVISION

JUNE-JULY.—A combined June-July meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, July 5, 1945, at 8:00 p.m. in Room 2503, Life Sciences Building, University of California, Berkeley, with President W. I. Follett in the chair. The minutes for May were read and approved.

Five proposals for membership were read: Fredonia Buell, 2325 McKinley Ave., Berkeley, California, proposed by Hilda W. Grinnell; Chapman Grant, 2970 6th Ave., San Diego 3, California, proposed by Alden H. Miller; Mrs. M. Vincent Mowbray, 350 Congress Ave., New Haven 11, Connecticut, proposed by M. Vincent Mowbray; Betty Ruth Schuck, Department of Zoology, University of California, Life Sciences Building, Berkeley 4, California, proposed by Jean M. Linsdale; and Clarence Andrew Sooter, Soil Conservation Service, P. O. Box 1460, Alice, Texas, proposed by Alden H. Miller.

President Follett reported the signing by Governor Earl Warren of two bills opposed by the Club: Assembly Bill 89 provides for the payment of bounties on crows; Assembly Bill 1239 creates the Mt. San Jacinto Winter Authority with power to construct a tramway for skiers in this State park.

Opening the field observations, Mrs. G. Earle Kelly reported that on July 4 shorebirds were again present in large numbers and variety in Alameda. A Song Sparrow in Alameda and another in Oakland in June were each feeding a young Cowbird. Commander W. A. Hicks saw a White-headed Woodpecker (female) in Ross on June 24. Dr. Alden H. Miller observed three colonies of murre in Marin County on July 1—one off Double Point, another near the mouth of Bear Valley, and the major colony of about a thousand young and adults one mile north of Bear Valley. Near this last location he also observed the flight under water of Pigeon Guillemots. On June 22, President Follett saw a pair of vultures near Belden, Plumas County, where observation since 1910 had not previously indicated their presence. A California Jay after some months has become tame enough to take peanuts from his fingers. Miss Amy Rinehart reported nesting of the Hooded Oriole in palm trees on Carrington St., near 40th Ave., Oakland, on June 28.

The speaker of the evening, Dr. Jean M. Linsdale of the Museum of Vertebrate Zoology, University of California, Berkeley, told of the work being carried on at the Museum's field station, the Hastings Natural History Reservation in Monterey County. Kodachrome motion pictures by Mrs. T. Eric Reynolds and Dr. Linsdale were shown.

Adjourned.—RUTH ELWONGER, *Acting Secretary*.

AUGUST.—The regular monthly meeting of the Northern Division of the Cooper Ornithological Club was held on Thursday, August 23, 1945, at 8:00 p.m., in Room 2503 Life Sciences Building, University of California, Berkeley, with President W. I. Follett in the chair. There were two proposals for membership: Mr. Fisher C. Bailey, 1220 Ralston St., Reno, Nevada, by Seth B. Benson, and Lt. (j.g.) George Petrides, St. Mary's College, Moraga, California, by Robert W. Storer.

The president announced the death of George Willett on August 2 and appointed Mrs. Grinnell chairman of a committee to prepare a resolution for the Northern Division.

Mr. Harwell told of a recent trip to Florida which included the photographing of Everglade Kites. This species, reduced in its range to the tule margins of Lake Okeechobee, can now be expected to increase in numbers as a result of the Soil Conservation program raising the water level over large areas. At Jackson Hole, Mr. Harwell saw four Trumpeter Swans with three cygnets, the adults having been transplanted there last year. He also reported the flooding of Lower Klamath Lake and its return after many years to conditions suitable for wildlife.

David Cutler observed White Pelicans in Alaska August 23. Commander Hicks reported seeing a White-tailed Kite on July 27, six miles south of Santa Rosa.

Mr. Ray reported that in the Tahoe region, near the California-Nevada state line, he took a set of three eggs of the Goshawk, in the latter part of April.

The speaker of the evening was Lt. (j.g.) Charles G. Sibley, who gave a comprehensive account of the avifauna of Emirau Island, St. Matthias Group, Bismarck Archipelago. Kodachrome slides introduced the four habitats occurring on this small coral island. Lt. Sibley described and illustrated by means of study skins many of the 44 species of birds found there.

Mrs. Harold C. Austin announced that the Army has withdrawn its request to use Point Lobos State Park for launching and target practice. She suggested, however, the completion and filing with the State Park Commission of a petition protesting military use of this Reserve.

Adjourned.—RUTH ELWONGER, *Acting Secretary*.

SOUTHERN DIVISION

MAY.—The monthly meeting of the Southern Division of the Cooper Ornithological Club was called to order on May 29, 1945, at 8:00 p.m., by President Walter W. Bennett, in Room 145, Allan Hancock Foundation, University of Southern California, Los Angeles, California.

The following names were proposed for membership: William Ryan Dawson, 2117 Tenth Avenue, Los Angeles 16, California, by George Willett, and William Daniel Quattlebaum, 1925 Paloma Street, Pasadena 4, California, by Dorothy E. Groner.

The following resolution was unanimously adopted:

WHEREAS, in the death of Herbert Newby McCoy on May 7, 1945, the Cooper Ornithological Club has lost a valued member, ex-president of the Southern Division and member of the Board of Governors; and

WHEREAS, although McCoy's principal scientific achievements were in a field other than ornithology, he had a strong personal interest in the Club and was always ready to support its activities; and

WHEREAS, his friendliness, courtesy, and unfailing generosity endeared him to all who were in close contact with him;

NOW, THEREFORE, BE IT RESOLVED, that the Southern Division of the Cooper Ornithological Club expresses its sorrow at the loss of an esteemed member and friend; and

BE IT FURTHER RESOLVED, that a copy of these resolutions be sent to the bereaved wife, together with an expression of our very sincere sympathy.

The status of A. B. 89, concerning crow bounties, was discussed. A communication from the Committee on Conservation of the Southern California Academy of Sciences was read by George Willett informing us that government engineers are studying plans to erect a diversion dam which, if constructed in the location now being considered, would eliminate the existence of the San Gabriel Wild Life Sanctuary on Duffer Road, El Monte, and that an alternate site for this diversion project had been, or might be considered. It was moved, seconded and carried that the Southern Division lend its strength toward the saving of this area, so ideally adapted to the preservation of an ecologic complex of undisturbed primitive river channel flora and fauna.

The Southern Division went on record as opposing A. B. 1239 which creates the Mount San Jacinto Winter Park Authority. The passage of this bill would alter the purpose for which the area was set aside as a State Park.

G. G. Benjamin presented a short résumé of observations of birds he had made recently on the island of Oahu. A. J. van Rossem gave highlights of his recent trip with Loye Miller to the Pajarito and Baboquivari mountains in Arizona, where they were attempting to work out the ranges of certain birds along the broken mountain chains near the Mexican border.

Adjourned.—DOROTHY E. GRONER, *Secretary*.

For Sale, Exchange and Want Column.—Each Cooper Club member is entitled to one advertising notice in any issue of *The Condor* free. Notices of over ten lines will be charged for at the rate of 15 cents per line. For this department, address JOHN MCB. ROBERTSON, Buena Park, California.

WANTED—The following issues of bird magazines: *Bulletin Nuttall Ornith. Club*, vol. 1, nos. 1, 2, 3, 4; vol. 2, nos. 3, 4. *The Auk*, vol. 1, nos. 1, 2, 3; vol. 2, nos. 2, 3, 4; vol. 3, no. 4; vol. 5, no. 1; vol. 6, no. 1. *Bulletin Cooper Ornith. Club*, vol. 1, all nos. *The Condor*, vol. 2, nos. 2, 5; vol. 7, all nos. I will pay good cash prices, or offer exchange in United States postage stamps prior to the Civil War, or your choice from my large book stock.—FRED J. PIERCE, *Winthrop, Iowa*.

FALL BOOK CATALOG NOW READY—Listing a fine selection of books on birds, mammals, reptiles, insects, plants and other natural history subjects. Many state bird books in stock as well as serial publications.—FRED J. PIERCE, *Dealer in natural history books, Winthrop, Iowa*.

WANTED—For study, a few bird skins, warblers, hummingbirds, grosbeaks, orioles, tanagers and a few others. Will appreciate hearing from collectors who can supply any of these.—ROBERT F. BACKUS, *Box 27, Florence, Colorado*.

FOR SALE—Check-list of the Birds of Nebraska, by Haeker, Moser and Swenk. Reprinted from *The Nebraska Bird Review*, vol. 13, May, 1945. Forty pages, heavy paper cover. Fifty cents per copy.—DR. R. ALLYN MOSER, *R.F.D. No. 1, Omaha 4, Nebraska*.



